AMERICAN ANTIQUITY

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AMERICAN ANTIQUITY

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EDITORIAL

With this issue of AMERICAN ANTIQUITY the Society for American Archaeology begins its twenty-fifth year of publishing a quarterly review of American archaeology. This issue includes some new features which have been made possible by circumstances completely unrelated to this event. Nevertheless, these innovations may serve as appropriate reminders of the growth of the Society in its first quarter century of service to the students of New World prehistory.

We hope that you have already noticed that this issue is much larger than usual and that you will look forward to receiving future issues of AMERICAN ANTIQUITY in this newly expanded form. This increase in the number of pages an issue is a direct result of the increase in dues a few years ago. The first result of the raise in dues was that the Society was enabled to operate in the black. The second result is that the increased income from dues and a steady growth in membership have improved our financial position to the extent that it is now possible to publish more pages in every issue of AMERICAN ANTIQUITY. This expansion of our publication program will substantially reduce the current backlog of unpublished manuscripts and thereby shorten the length of time between the acceptance of an article and the publication of it. Moreover, the new binding method will make it possible to publish longer articles, especially if some publication subsidy is available.

A second new feature which is being introduced in this issue is the publication of an abstract for each article and for each shorter contribution in the "Facts and Comments" section. Beginning in 1960 these abstracts will be reprinted as the nucleus of an annual volume of abstracts of the previous year's literature which bears on New World archaeology. This new series of abstract volumes has been made possible by a generous gift to the Society from the Charles F. Brush Foundation. The abstracts will be prepared under the general editorship of Richard B. Woodbury who will be assisted by a group of area specialists. More details will be available in the next issue of AMERICAN ANTIQUITY. In the meantime, authors are reminded that henceforth an abstract modeled after those in this issue must accompany every manuscript submitted for publication in this journal.

An organization which has already served archaeologists a full twenty-five years is the Tree-Ring Society, which published Volume 1, Number 1 of its journal in July, 1934, one year before the Society for American Archaeology began the publication of AMERICAN ANTIQUITY. The Tree-Ring Society publishes the *Tree-Ring Bulletin* with the cooperation of the Laboratory of Tree-Ring Research of the University of Arizona. The *Tree-Ring Bulletin*, which is now in its twenty-second volume, accepts original papers on all phases of tree-ring research. It has been the traditional medium for the publication of tree-ring dates and of technical studies of archaeological tree-ring materials from various parts of the world, especially the Southwest and the Arctic.

The Society for American Archaeology adopted this resolution at its 24th Annual Meeting:

> In recognition of the quarter-century of inquiry and vigorous research sponsored by the Tree-Ring Society, and of the contribution by members of the Society in the application of tree-ring research in the fields of climatology, hydrology, and especially the dating of prehistoric sites: be it resolved that the future development of tree-ring research be supported and encouraged in spirit, by the Society for American Archaeology, and in substance by whatever means may be available.

The most substantial means of supporting and encouraging the work of a scholarly organization is active membership. Applications for membership in the Tree-Ring Society should be sent to its Secretary, C. W. Ferguson, Department of Watershed Management, University of Arizona, Tucson, Arizona. Manuscripts for publication in the *Tree-Ring Bulletin* should be submitted to the Editor, Bryant Bannister, Laboratory of Tree-Ring Research, University of Arizona, Tucson, Arizona.

THE LEHNER MAMMOTH SITE, SOUTHEASTERN ARIZONA*

EMIL W. HAURY, E. B. SAYLES, AND WILLIAM W. WASLEY

ABSTRACT

In 1955–56 the Arizona State Museum excavated an elephant-kill site on the Lehner ranch in the San Pedro valley, near Hereford, Arizona, and found 13 projectiles, mainly Clovis fluted points, eight butchering tools, and charcoal from two fires among the remains of nine immature mammoths and elements of horse, bison, and tapir. Bones and artifacts occurred on and in gravels of a former perennial stream exposed in the modern arroyo bank. Most or all of the animals were probably killed over a comparatively short period by hunters identified with the Llano complex by the Clovis points. The Lehner site and the nearby Naco site represent the southwesternmost extent of the presently known range of the Llano complex. The post-kill sequence of alluviation and erosion supports a geological age of 13,000 or more years for both bones and artifacts. Arizona, Michigan, and Copenhagen radiocarbon measurements of hearth charcoal indicate a date of 11,000 to 12,000 B.P. Since these dates are substantially older than the oldest radiocarbon assays for the Sulphur Spring stage of the Cochise culture, it is probable that the transition from big-game hunting to collecting is reflected in the change from Llano complex to Cochise culture, and that this shift in economic emphasis took place before the complete extinction of the late Pleistocene megafauna.

IN THE SPRING OF 1952, while the Arizona State Museum of the University of Arizona was engaged in the excavation of the Naco Mammoth site, Edward F. Lehner was inspecting property he anticipated purchasing about two miles south of Hereford on the west side of the San Pedro River in Cochise County, southeastern Arizona (Fig. 1). Lehner noted and examined the stratified deposits exposed in the vertical bank of an arroyo channel which crossed the property. At the base of this bank, about 2.5 m. below the modern surface, he noticed bones exposed by the erosion of the channel. Lehner's natural curiosity was piqued by the occurrence of bones at this depth. He probed a bit and concluded that the bones might be those of some extinct animal life and therefore ought to be of scientific interest or value. He carefully removed a few of the fragments and took them to the Arizona State Museum where some of them were identified as the tooth plates of mammoth.

A few days later Haury examined the site and observed that the geology generally duplicated the situation at Naco (Haury, Antevs, and Lance 1953: 5, Fig. 3) where work was then in progress. The age of the deposit appeared to be recent enough to warrant the hope that associated human artifacts might be present. However, no direct evidence of this association was observed. During the next two years the mammoth exposure was revisited several times. Ernst Antevs examined the locality and concurred in the belief that the mammoth remains could have been deposited within the time range of human habitation in the Southwest.

After the particularly heavy summer rains of 1955, Lehner, who by then had acquired the property, advised Haury on September 17 that much more bone had been exposed. The following week the site was visited by John F. Lance and Wasley. Bone was exposed laterally for about 15 m. in the same stratigraphic horizon. No articulation of bone was observed, but the relationship of skeletal elements and the general condition of the bones seemed to preclude the chance that they were redeposited, although even then, with much more bone exposed, no evidence of man was noted. Nevertheless, the decision was reached that exploratory excavation was justifiable.

Excavations were conducted under the over-all direction of Haury between November 28 and December 19, 1955, and between February 5 and March 4, 1956. Antevs, Lance, and Sayles participated directly in the project. The reports by Antevs and Lance, on the geological and paleontological aspects of the discovery, accompany this paper. Wasley acted as field supervisor throughout the excavations. Graduate students in the Department of Anthropology of the University of Arizona who contributed freely of their time and labor included: William J. Beeson, Rex E. Gerald, James S. Griffith, Elizabeth Ann Morris, and Arthur H. Rohn. Special acknowledgement is due Austin Jay, Cochise County Supervisor for the Bisbee District, who rendered the fullest cooperation during both phases of the excavation in providing a power shovel and crew for the removal of overburden amounting to over a thousand tons; Jack Riggs, foreman of the district highway crew; Mrs. Donna Gentry, Martin Gentry, and James MacNulty of Bisbee, and Lt. George Megginson of Fort Huachuca for services and courtesies rendered throughout the excavations. No finer example of the cooperation between the interested amateur and the professional is to be found than that provided by Mr. and Mrs. Lehner from start to finish during the protracted period of investigation. They were perfect hosts to the miscellaneous "-ologists" and to the hundreds of visitors who descended upon them during the course of the proceedings, and yet they found time to assist with the digging, to provide refreshments

* See also Lincoln Barnett's popular account of the Lehner Mammoth find in *Sports Illustrated*, Vol. 5, No. 16, pp. 52–60, October 15, 1956.

· Contribution No. 11, Program in Geochronology, University of Arizona.

for the excavation crew, and to perform a variety of other services and courtesies. From the beginning Lehner manifested a deep and abiding interest in and an acute comprehension of the more involved problems of excavation, analysis, and interpretation. To the Lehners go our sincere thanks and respect for the role they have played in contributing so materially to the knowledge of early hunters in the Southwest.

Climate and Ecology

The upper San Pedro valley is a broad, relatively flat, alluvium-filled valley of the Basin and Range physiographic province. On the west it is flanked, in the general vicinity of the Lehner ranch, by the rugged Huachuca Mountains

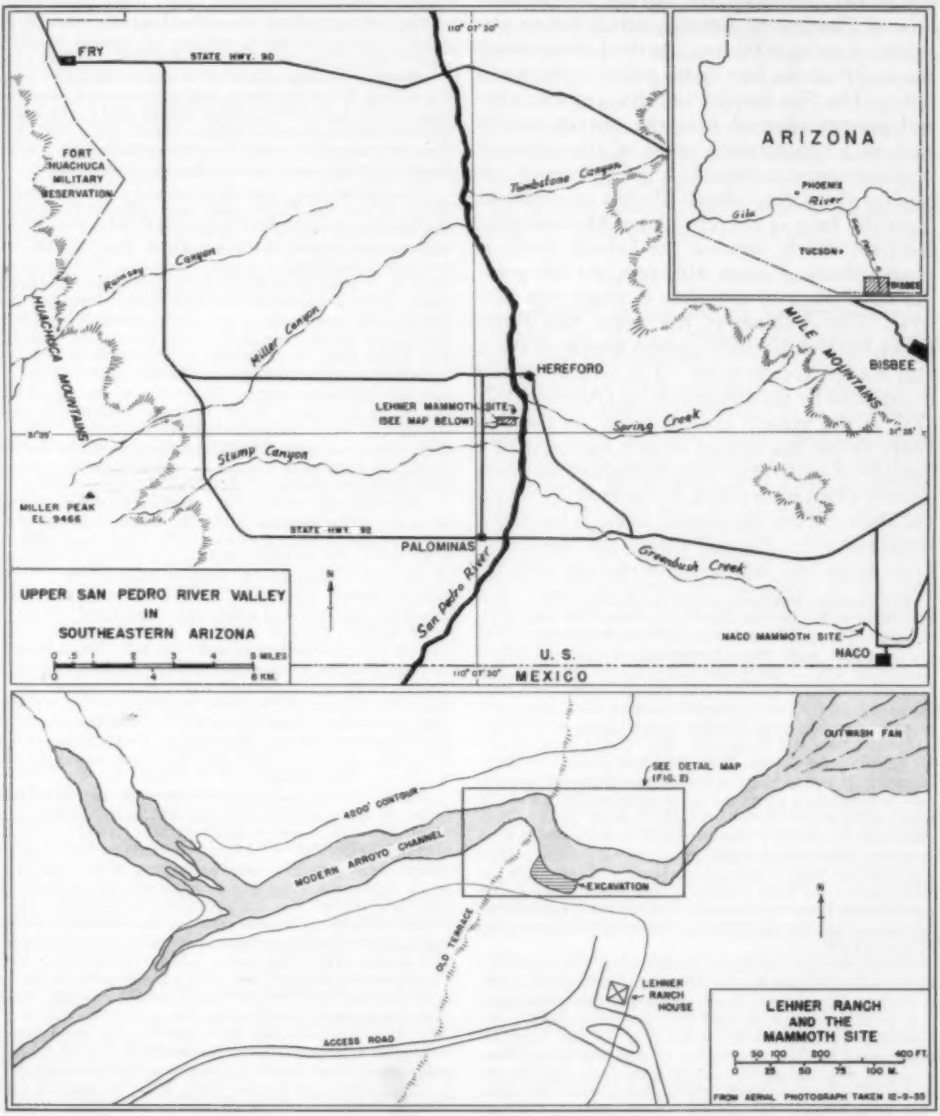

Fig. 1. General map of the Hereford area, southeastern Arizona, and detail map of the Lehner ranch showing location of the mammoth excavation.

which reach an elevation of 9466 feet at Miller Peak (Fig. 1). On the east the valley is bordered by the less imposing Escabrosa-Mule Mountains. The San Pedro River rises at an elevation of about 5000 feet in the rolling prairie country north and east of Cananea, Sonora, Mexico. The upper valley of the river extends northward across the international border to the area around Charleston, Arizona, which has an elevation of about 4000 feet. At the Lehner ranch the width of the San Pedro valley is about ten miles. The San Pedro River has cut its valley and present channel near the eastern margin and, as a consequence, most of the tributary drainages trend eastward. Over a series of low terraces these drop about 700 feet in elevation from the base of the Huachuca Mountains to the river which, opposite the Lehner ranch, is at an altitude of about 4160 feet. At this point the flood plain of the river is about one mile wide. The drainage of the upper San Pedro valley has the dendritic pattern typical of Basin and Range topography. It is characterized throughout by the arroyo cutting (Antevs 1952: 375) of the present erosion cycle. In the San Pedro valley this type of erosion has exposed a number of early man sites, including the Naco station. Greenbush Creek, in the banks of which the Naco site was discovered, is one of the major tributaries from the east joining the San Pedro River about one mile south of the site (Fig. 1).

The Present. In general terms the climate of the upper San Pedro valley may be described as semi-arid and mesothermal. The precipitation of the region averages 12.75 inches a year, with almost two-thirds of this total falling during the July to September rainy period. In April and May the average is 0.2 and 0.15 inches, respectively, and 0.5 to 0.8 inches are expectable during each remaining month. Temperatures roughly match those at Douglas, Arizona, where the means are 44.5° F. for January, 79° for July, and 62° for the year. The flow of the San Pedro is perennial but in the dry season the discharge is minimal or subsurface along many stretches of the valley. In terms of Thornthwaite's (1948, Pl. 1) more detailed classification, the valley is characterized as semi-arid, with a moisture deficiency surplus index of –20 to –40; third mesothermal with a thermal efficiency of 33.66 inches to 39.27 inches; no water surplus in any season; and a temperature-efficiency regime normal to fourth mesothermal, having a summer concentration of thermal efficiency from 48% to 51.9%.

On the basis of ecological classification, the upper San Pedro valley belongs to the Apachian biotic province described by Dice (1943: 56–8). Although this biotic province is characterized by four life zone belts, desert, arid grassland, encinal, and montane, only the last three are represented in the upper valley of the San Pedro River, which is at a higher altitude than that required for the desert. The arid grassland which characterizes the valley floor is composed primarily of short grasses, although taller grasses are common along the drainages. Black grama and blue grama predominate among the short grasses, but at this altitude there are also other grama species as well as grasses such as dropseed and seed muhly. The tall grasses are represented chiefly by sacaton which grows in swales in competition with tobosa (Nichol 1952: 206–7). Encroaching upon the arid grassland belt are mesquite and blackbrush or tarbush, usually occurring separately in relatively pure stands, but occasionally mixed. The latter situation is sometimes accompanied by small colonies of creosote bush and cat's-claw (Nichol 1952: 211). Small relict islands of cottonwood, willow, ash, and oak are mainly confined to the stream channel of the San Pedro River.

The encinal belt of the hills along the sides of the valley is characterized by various oak species of which Emory is the commoner form in this area. Ground cover is provided to some extent by the curly mesquite grass. Cat's-claw, desert hackberry, and mesquite are also common in this belt (Nichol 1952: 207–8), and in the higher altitudes there are some juniper stands (Dice 1943: 58). The montane belt of the Huachuca Mountains consists largely of pines, some spruce, Mexican ash, and oak.

The Recent Past. Less than a century ago the general aspect of the San Pedro valley was different from today in a number of respects. The entrenchment of the stream began at the mouth of the San Pedro River in 1883 and proceeded headward at a rate of about 125 miles in ten years by a process of progressive arroyo cutting (Bryan 1925: 342). Roe Martin and Jack Parker, longtime residents of the upper valley, recall that about 1910 to 1914 the channel of the river at Hereford was narrow and only 2 to 3 feet deep. F. B. Moson, another early rancher, remembers the Hereford area in the 1880's and 1890's before entrenchment began. He recalls when the stream was no more than a series of grassy swales and when springs and seeps occurred along the valley floor. During these years the present tributary arroyo on the Lehner ranch was itself only a swale in which there was a seep. Channel cutting began in this tributary in the 1920's.

The literature of the 19th century provides descriptions of conditions seen in the San Pedro valley prior to 1860: by James Ohio Pattie in 1825 (Thwaites 1905: 99–104), by Cooke in 1846 (Bieber and Bender 1938: 140–7), by Parry (1854: 18) in 1852, by Parke (1857: 123–5), and by Hutton (1859: 79–80, 87–8). These consistently describe a grass-covered valley with small stands of cottonwood, walnut, ash and some oak along the water course. The river supported beaver and some fish. Mesquite trees growing along portions of the valley were large enough to provide timbers for Spanish and early American buildings. Descriptions of the upper San Pedro valley of Kino's time in the early 18th century by Velarde (Wyllys 1931: 126–30) and by Mange (Karns 1954: 77–83) indicate that the environment was about the same as it was in the first half of the 19th century.

Cattle and horses were introduced to the San Pedro valley by Kino in 1696 when he left "a few cattle and a small drove of mares" at Quiburi, near modern Fairbank (Bolton 1948, Vol. 1: 165). Throughout the Spanish period there appear to have been some cattle in the area at all times, but large herds occurred only periodically (Di Peso 1953b: 34). However, during the early 1800's sizable herds of cattle were raised in southeastern Arizona, particularly at the San Bernardino ranch east of Douglas and in the upper San Pedro valley (Cooke 1848: 555). During the middle and late 1830's the Apache succeeded in driving the Mexicans from southeastern Arizona, seizing their horse herds, and leaving the cattle to revert to the wild state in which they were found by the early Anglo-American explorers and the hundreds of forty-niners who took the southern route to California (Bartlett 1854, Vol. 1: 256; Bieber and Bender 1938: 133). It was not until the 1870's that cattle ranching was reintroduced to the upper San Pedro valley (Wagoner 1952: 42). Since that time the cattle industry has taken on great importance in southeastern Arizona.

The preceding sketch is an attempt to present a diachronic view of the region. Several noticeable environmental changes took place in the brief span of a hundred years: (1) denudation of grassland areas by overgrazing of cattle, (2) encroachment of mesquite and blackbrush upon the weakened grassland areas, (3) decided lowering of the water table and the consequent complete disappearance of beaver and fish and the near disappearance of the large deciduous tree growth along the river, and (4) extensive arroyo cutting to a mean depth of 15 to 20 feet (Humphrey 1958). While it is generally felt that these changes might have come eventually as a natural consequence of climatic change, it is also a concensus that overgrazing and other activities of man probably triggered and hastened these changes. If the present cyclonic storm pattern, which produces excessive precipitation during the summer months and virtually none at all during the remainder of the year, began in the 1880's, as has been suggested by some observers, then the coincidence of this timing may also be drawn upon to explain the rapidity of the change. Whatever the cause or causes for these recent changes the analogy is clear that past changes of similar or even greater magnitude must be envisioned to provide the physical setting for the evidence in the Lehner site.

We can only conjecture what the upper San Pedro valley may have looked like to the big game hunters of 10,000 years ago. The environment may still have presented essentially a grassland, dotted with small stands of trees and shrubs, and dominated by species which thrived in a cooler climate than the present. Pollen studies now in progress should shed light on this problem. Dillon (1956: 168–9) has suggested that perhaps a decrease of 10° F. in the mean annual temperature and more moisture would produce the conditions presumed to have existed in the period of maximum glaciation during the Wisconsin. Considerably less change in temperature and precipitation would have been required to duplicate the conditions believed to have been prevalent 10,000 years ago.

Location of the Site

The Lehner Mammoth site (Cochise County, T23S, R22E, Sec. 21, n½ nw¼ nw¼ nw¼) is designated as Arizona EE:12:1 in the Arizona State Museum archaeological survey (Wasley 1957). It is about 0.4 miles west of the present channel of the San Pedro River, on a small tributary entrenched by arroyo cutting for a distance of about 0.25 miles above (west of) the site and for about 0.1 miles below the bone bed. At the lower end of this arroyo the tributary fans out onto the flood plain of the San Pedro River so that it does not now actually extend to the entrenched river (Fig. 1). In the immediate vicinity of the site, the source of the arroyo channel has been deflected southward by a partially buried terrace remnant composed of sediments older and more resistant to erosion than the more recent deposits of the valley fill. This deflection of the channel was a happy circumstance, for a less acute change would not have brought the bones to view. At this point the modern arroyo channel is about 25 m. wide (Fig. 2). The elevation of the site is 4190 feet.

Excavation Procedure

The work on the Lehner Mammoth site was carried out in two phases: excavation of the bone bed in December, 1955 (Figs. 3, 4), and excavation of the hearth area in February, 1956. The latter extended westward from the western limit of greatest bone concentration. With the exception of minor differences in detail to be noted later, the excavation procedures followed at the bone bed and at the hearth area were similar. The overburden above the areas to be excavated was removed by means of a power shovel. A "cushion" of soil about 50 cm. thick was left over the bone bed to prevent crushing and disturbance of the bones. This was stripped by hand labor as the second step. When the complexity and extent of the bone bed became known, a 1-meter grid system was superimposed over it to facilitate mapping and recording of pertinent data. The grid was extended westward to encompass the area containing the hearths exposed during the second phase of excavation. The rapid deterioration of the bone after exposure to the drying air, the complicated arrangement of the bones, and their vertical distribution precluded complete excavation and mapping of the site as a unit. Expediency dictated that as one segment or level was exposed, mapped, and recorded, the bones should be removed before proceeding to the next segment or level of the excavation. Photographic procedures, necessarily, had to conform to this scheme. For this reason it was not possible to include in a single photograph the completely excavated bone bed showing its relationship to the relevant geological features.

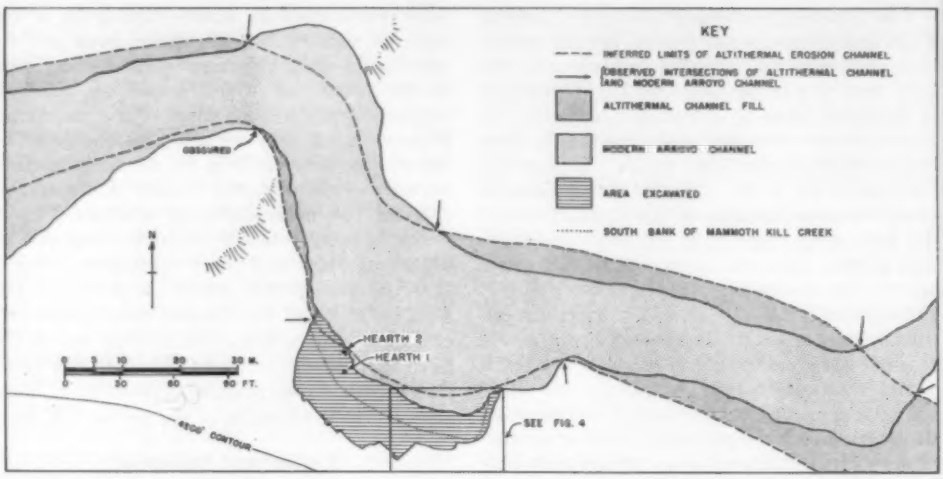

Fig. 2. Detail map of the Lehner Mammoth site in relation to the modern and Altithermal arroyo channels.

The Bone Bed

The top 2 m. of silty deposits over the bone bed were progressively less sandy and more clayey from top to bottom. Underlying this was a distinctive dark band, almost black in color, representing a silty clay soil with some humic content. The thickness of this deposit varied from 5 to 25 cm. with an average of 15 cm. The exposed bones in the arroyo bank prior to excavation appeared to lie directly below this black layer, a fact substantiated later by digging. The extent of the area from which the overburden was removed by power shovel was about 11 m. back into the bank and 17 m. along the face of the arroyo bank — where the bones seemed to be most heavily concentrated.

The uncovering of the bones began at the eastern edge of the excavation and the first artifacts were found shortly afterwards within 20 cm. of the arroyo face. These consisted of two Clovis fluted projectile points, one touching and the other near rib fragments (Nos. 1, 2, Fig. 4). About this same time a few flecks of charcoal were observed in the sandy matrix surrounding the bones. These finds amply justified continuation of the project because they demonstrated some sort of association of man and mammoth.

By the time the first phase of the excavation was completed, elements of eight mammoths, identified by lower jaws, were counted. Bones of bison, represented definitely by a jaw fragment containing three teeth and vertebral fragments, emerged near the western edge of the bone bed. Found directly with the bones, either near bone as between two ribs (Fig. 5) or actually touching bone, were 13 projectile points, eight cutting and scraping implements, one chopper and eight miscellaneous chips and flakes. The latter probably represent refuse from tool making on or near the spot. In no instance were the projectile points observed to have penetrated bone. Small scraps of charcoal became somewhat more abundant towards the western, or upstream, end of the excavation. As much as possible of this was saved for radiocarbon dating. The source of this charcoal became apparent only after the second phase of the excavation was undertaken in February, 1956.

The condition of the bone encountered was uniformly poor. The structure was spongy upon fresh exposure and often the articular surfaces were disintegrated. For this reason, fully articulated bones could be demonstrated in only one instance. This was a fragmentary maxilla with tusk, containing a tooth in perfect occlusion with its mate in the mandible (Fig. 6). Nevertheless, articulation was strongly suggested in other instances: a radius and ulna side by side, their proximal ends close to the distal end of a humerus, assuming a semiflexed position with respect to the latter; a tibia in similar relationship to a femur; sets of ribs found in sequence with respect to size, the ribs of each set oriented in the same direction. These instances of presumed articulation occurred for the most part toward the eastern end of the bone bed.

The matrix surrounding the bones consisted partly of a white, uniform, fine sand (Fig. 4 *i*) locally grading to silt and clay (Fig 4 *j*), partly of sand mixed with gravel (Fig. 4 g), and partly of a redeposited reddish clay with caliche inclusions (Fig. 4 *h*), which was moderately interfingered with gravel. The fine white sand occurred most continuously at the eastern end of the bone bed thinning towards the west to lenses and pockets in low spots in the uneven surface of the gravel. Where thickest at the eastern end, this sand may have helped to preserve the bone by acting as a close-fitting pad or cushion which provided better subsurface drainage, thereby resulting in the best examples of articulation.

In the face of the evidence at hand it was concluded early in the excavation of the site that the animals represented in the deposit, or at least some of them, were killed by man. Further, it seemed clear that the slaughter took place on a sand and gravel bar of an ancient perennial stream channel, hereafter referred to as Mammoth Kill Creek. In tracing the south bank of this stream, we were able to determine that Mammoth Kill Creek took a course roughly paralleled by the modern arroyo (Fig. 2), although the south bank, in the area of excavation, was about 4 m. south of the modern arroyo. The same buried terrace which diverted the course of the modern arroyo also diverted in a similar manner the channel of Mammoth Kill Creek, so that a sharp bend was formed. At one time the current of Mammoth Kill Creek ran along the south bank, or the outside of the bend, carving an almost vertical bank 1.8 m. high, and scouring its channel most deeply in this place.

FIG. 3. Area of bone and artifact concentration uncovered by first phase of the excavation. Looking west. Scaling stick in background is 3 m. long.

Eventually, when aggrading began, the south side of the channel filled with gravel and with tumbled portions of the red clay bank, while the main stream may have cut a shorter course somewhat farther to the north. The area along the south bank then became a relatively quiet, shallow, freshwater pool, an ideal watering place for game animals and an ideal hunting place for man. In this pool the fine white sand was deposited during the time of the mammoth hunts and perhaps for a short time afterwards.

In one or two places the depth of the bone bed, between the highest projection and the lowest submergence of bone in a vertical line, was a little over 1 m. The highest bone, primarily elements of some of the lower jaws, protruded into the black soil overlying the bone bed. The lowest bone, consisting of the tip of a tusk and a pelvic section, extended downward near the bottom of the stream channel of Mammoth Kill Creek. The tusk was buried in material that had sloughed off the south bank (Fig. 6) while the section of pelvis was in the zone of the interfingering of the bank material and the bar gravel. This situation suggests that the first animals were killed while the gravel bar was still forming and before the deposition of the white sand, and that the last animals were killed after at least a portion of the white sand had been deposited. Thus, there is a strong indication that not all of the animals were killed at one time, but that this was the site of a series

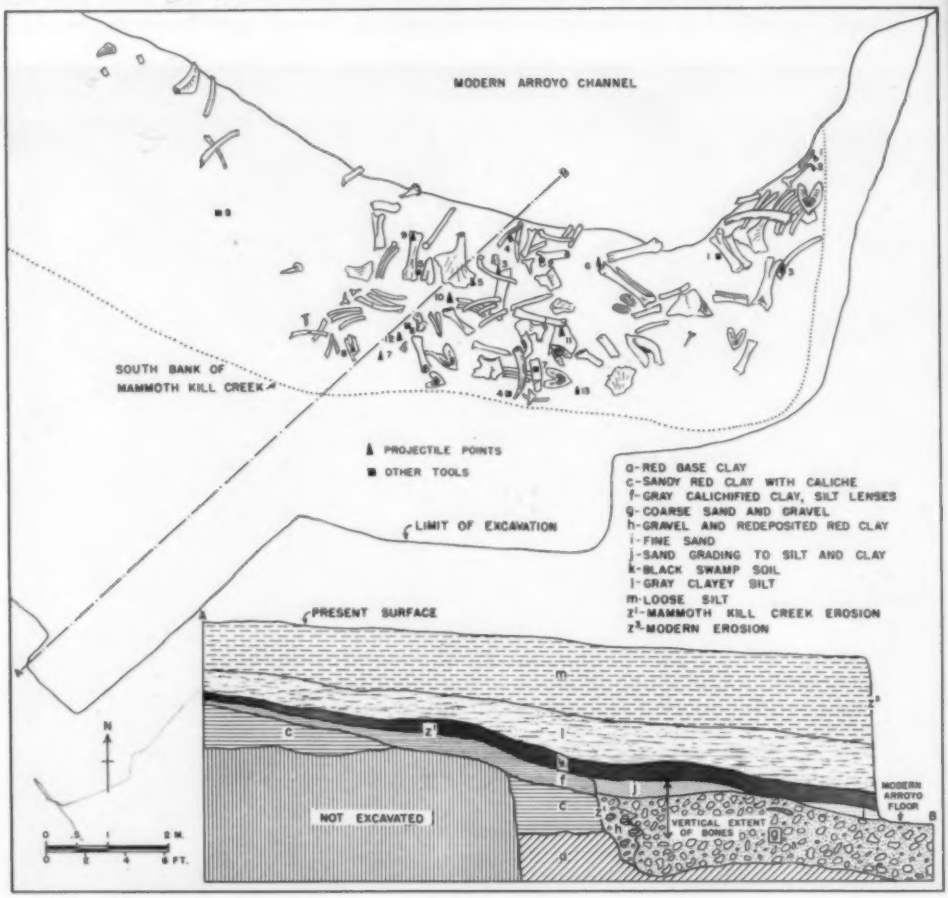

Fig. 4. Area of bone and artifact concentration, and geological profile. Main bone elements only are shown. Deposits *b*, *d*, *e*, n, and *o* and erosion Z^2 do not appear in this profile but are shown in Figure 17. Bones occurred in deposits *g–j*.

FIG. 5. Clear quartz projectile point (Fig. 12 *c*) in situ among ribs, probably of young mammoth. Two overlying rib sections were removed to allow photography.

of elephant hunts extending over an indeterminate, though probably short, period of time.

The highest and lowest artifacts were separated by a vertical distance of about 70 cm. The highest artifact, projectile point 12 (Fig. 12 *j*, Table 1), was found about 10 cm. below the black soil, while the lowest, projectile point 11 (Fig. 12 *m*), was found near the upper portion of the pelvis fragment mentioned previously. These two projectile points are similar enough from a technological standpoint to have been made by the same craftsman. On this cultural evidence it would seem unwise to postulate any great length of time between the first kill and the last at this locality. That the lower of these two points was found essentially in situ and had not worked down through the bar deposit during the wallowing or thrashing of mammoths at the water hole is suggested by its position close to and pointing towards a wing of the pelvis mentioned previously, and by its broken tip as if it had actually struck this bone. The higher projectile point, in common with several of the others, was on top, or near the top, of the gravel bar, and certainly had not worked upward through the gravel deposit. For both bone and artifacts, the highest and lowest specimen occurred near the south bank of Mammoth Kill Creek where both bones and artifacts were most heavily concentrated.

Although the mandibles of eight mammoths were recovered from the bone bed during the first phase of the excavation, most of them in fair condition, it should be noted that not a single skull was found intact. The fragment of maxilla containing a tooth and a tusk (Fig. 6) was one of two instances in which only a small part of a cranium was preserved. Two or three masses of badly crushed flat bone were encountered which may have been parts of skulls, but these by no means account for all that once must have been there. While mammoth tongue and brains may well have been considered delicacies by the hunters, these parts could easily have been recovered without total destruction of the skull. Since a cranium was present at the Naco site (Haury, Antevs, and Lance 1953: 3), we must conclude that at the Lehner site skulls simply failed to survive both time and the hunter.

THE HEARTH AREA

Upon the completion of the work in the bone bed, it was apparent that at the eastern and southern margins of the excavation the extent of the bone concentration had been approximately delimited (Fig. 4). However, a number of problems were still unanswered with reference to what might lie to the west, or upstream. Tool 8 (Fig. 4) came from the face of the west bank of the excavation (Fig. 3) left at the end of the first phase of the operations. Some elements of bone were also visible here. Were there still more artifacts and more animals in the area beyond? Flecks of charcoal in the upper zone of the bone bed were observed to increase in abundance towards the upstream end of the area exposed and they were still to be found in the face of the west bank of the excavation. What was the source of this charcoal? Moreover, we wanted more information about Mammoth Kill Creek and about the geological events which preceded and followed it. These were the deciding factors which inspired the second phase of the excavation. This step, undertaken in February, 1956, involved opening an area immediately to the west of the initial excavation for a distance of about 19 m. and southward into the bank about 13 m. (Fig. 7). Overburden was removed by power shovel to the top of the black soil, so that less hand labor would be required. We now knew that the pay dirt was entirely underneath the black soil, and we risked crushing bone in order to save time and expense.

For convenience we have called this section of the excavation the hearth area to distinguish it from the bone bed. Relatively little bone was uncovered during this phase of the excavation. Those elements found included a portion of the lower jaw of a tapir, a horse podial, and the ninth mammoth jaw, all on the sand and gravel bar in Mammoth Kill Creek, and in the same geological context as the other bones. The south bank of this early stream was exposed in two more places. These, with the portions exposed during the first step of the digging, permitted us to plot the south bank of Mammoth Kill Creek (Fig. 2). Although no more artifacts were recovered in this area, further welcome evidence of man's activity was represented by two charcoal-laden hearths. These occurred on the sand and gravel bar. At its western end the bar consisted of a uniform medium sand, somewhat tan or grayish in color and at least 50 cm. thick. In the area of the hearths no excavation was made to the bottom of the sand deposit or to the bottom of the channel of Mammoth Kill Creek.

About 10 cm. of the tan sand deposit covered the top of Hearth 1, separating it from contact with the overlying black soil. This may be taken to indicate some flooding of the bar after the hearth was used. Hearth 1 was a pit of irregular basin shape in cross section, which measured 40 cm. in diameter at the top and was 35 cm. deep (Fig. 8). Hearth 2 was merely an extensive fire area, irregular in outline and without a pit or depression. A dense concentration of charcoal, consisting of a nearly solid mat 3 cm. or more thick, covered an area roughly 1.25 m. long and 70 cm. wide. Hearth 2 was on top of the sand bar's surface. The charcoal was separated locally from the black soil by small patches of fine white sand about 1 cm. thick and in a few spots it extended slightly into the overlying black soil.

The suggestion that these hearths were used for cooking meat lends credence to the idea that

Fig. 6. Excavation detail. At extreme left is clay bank (Fig. 4 *a*) of Mammoth Kill Creek. Fill in center is mixed clay and gravel (Fig. 4 *h*). At right is the coarse sand and gravel bar (Fig. 4 *g*). Tusk of young mammoth extends downward under caliche block; directly above, at top of column, is basal portion of the black swamp soil (Fig. 4 *k*). The tusk and supporting maxilla with tooth rests on matching tooth in lower jaw (arrow). Looking southwest.

FIG. 7. Second phase of excavation. Looking west.

they were contemporaneous with the time the animals were killed. In an area where bone was rather scarce, shattered elements of unidentifiable bone lay over the south edge of Hearth 1, while the tapir jaw fragment, slightly charred, was only 20 cm. from the northwest edge of the same pit. The difference in stratigraphic position suggests that Hearth 1 was the older of the two, but in all probability this does not represent a significant interval of time.

Charcoal from both hearths was saved for radiocarbon dating the results of which are reported below. Pieces in excess of 1 cm. in diameter were preserved for botanical identification. On the basis of determinations made by the Forest Products Laboratory at the University of Wisconsin and by T. L. Smiley of the University of Arizona Geochronology Laboratories, pine, ash, and oak were represented. Species of oak and ash are known to have grown along the San Pedro River in historic times, while pine is now confined to the Huachuca Mountains, some ten miles to the west. Hence, information from this source sheds little light on the problem of ecological differences that may have existed between the time of the kill and the present. The hearths underline the real motive for the chase — food, and hint that no time was lost in satisfying the hunger pangs of the hunters.

THE GEOLOGICAL EVENTS: A PREVIEW

Antevs' detailed analysis of the geology of the Lehner site follows this report. At this point it seems appropriate to review briefly the sequence of formations and events to provide the reader with some knowledge of the physical nature of

FIG. 8. Hearth No. 1 seen in cross section.

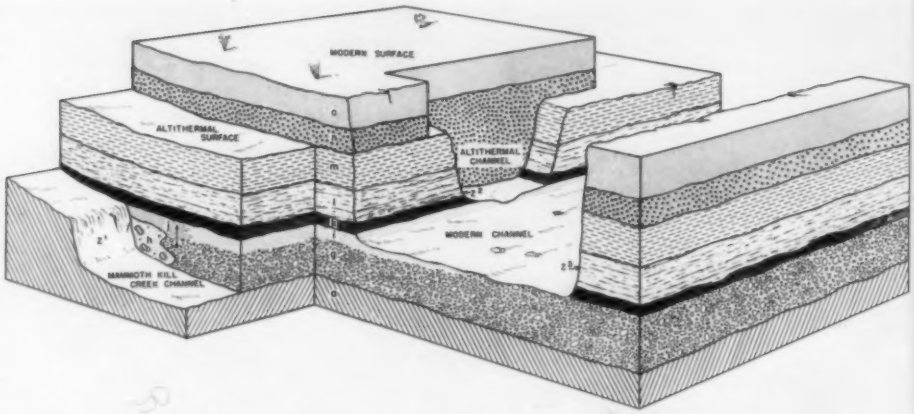

Fig. 9. Schematic reconstruction of the geological history of the Lehner Mammoth site. Periods of sedimentation and erosion are shown in true chronological order and in proportional scale but license has been taken with the axial relationship of the arroyos for clarity. Beds *b–f*, older than Z^1, have been omitted, but are shown in Figure 17. Arrow indicates vertical distribution of bones in deposits *g–i*. Erosion periods are: Z^1, south bank of Mammoth Kill Creek; Z^2, Altithermal arroyo channel (Fig. 11); Z^3, modern arroyo.

the station before discussing the artifacts and the dating and before embarking on the concluding section. We are not now concerned with the oldest deposits revealed by the excavations. Into these Mammoth Kill Creek eroded its channel (Fig. 9 Z^1). This perennial stream was in existence and started filling before the animals were killed. From the distribution of the bones in the gravels and sands (Figs. 9 *g-i*, 10 *g-j*) it appears that much of the filling took place during the time of the hunts.

Rapid deposition was then interrupted and local conditions were favorable for the development of a swamp. The record of this event is preserved by a distinctive, carbon-laden black layer (Figs. 9 *k*, 10 *k*). The evidence suggests that this swamp was basin-shaped in profile and semilunar in outline, curving around the base of an old hill which diverted the course of the older and younger streams. The swamp soil sloped upward more rapidly to the south than to the east and west. This reconstruction is partly conjectural because subsequent erosion removed all traces of its northern limits. The organic content of the swamp soil was sufficient to make possible radiocarbon assays.

The swamp soil was overlain by clayey silt (Figs. 9 *l*, 10 *l*) which, in turn was blanketed by loose silt (Figs. 9 *m*, 10 *m*). This period of deposition was followed by one of erosion of presumed Altithermal age. The resultant arroyo channel was easily observed at no less than seven places where the modern arroyo cut through it (Fig. 2) and was best illustrated by the exposure directly east of the bone bed (Figs. 11, 9 Z^2). In several places the Altithermal arroyo removed the swamp soil and it is presumed that it also destroyed a portion of the bone bed. Subsequent events include the complete filling of the Altithermal arroyo (Figs. 9 *n*, 11 *n*) and the accumulation of recent deposits (Fig. 9 *o*). The modern erosion cycle which began in the final decades of the last century has produced the present channel (Fig. 9 Z^3).

The Artifacts

The artifacts, whether points or cutting tools, clearly occurred in direct association with the bones (Fig. 4). In lateral and vertical distribution the greatest densities of bones and tools coincided. From this it is inferred, even though little evidence of bone articulation was observed, that negligible displacement of either tools or bones has taken place since the time of the kill. The possibility of accidental association of tools and animal remains through secondary deposition is certainly to be ruled out. It goes beyond all logic to attribute this kind of sorting to nature. Any lingering doubts as to the contemporaneity of animals and man are eliminated by the two hearths adjacent to and on the same level as the bones.

There are 13 projectile points, two of which were seriously damaged. The essential data for

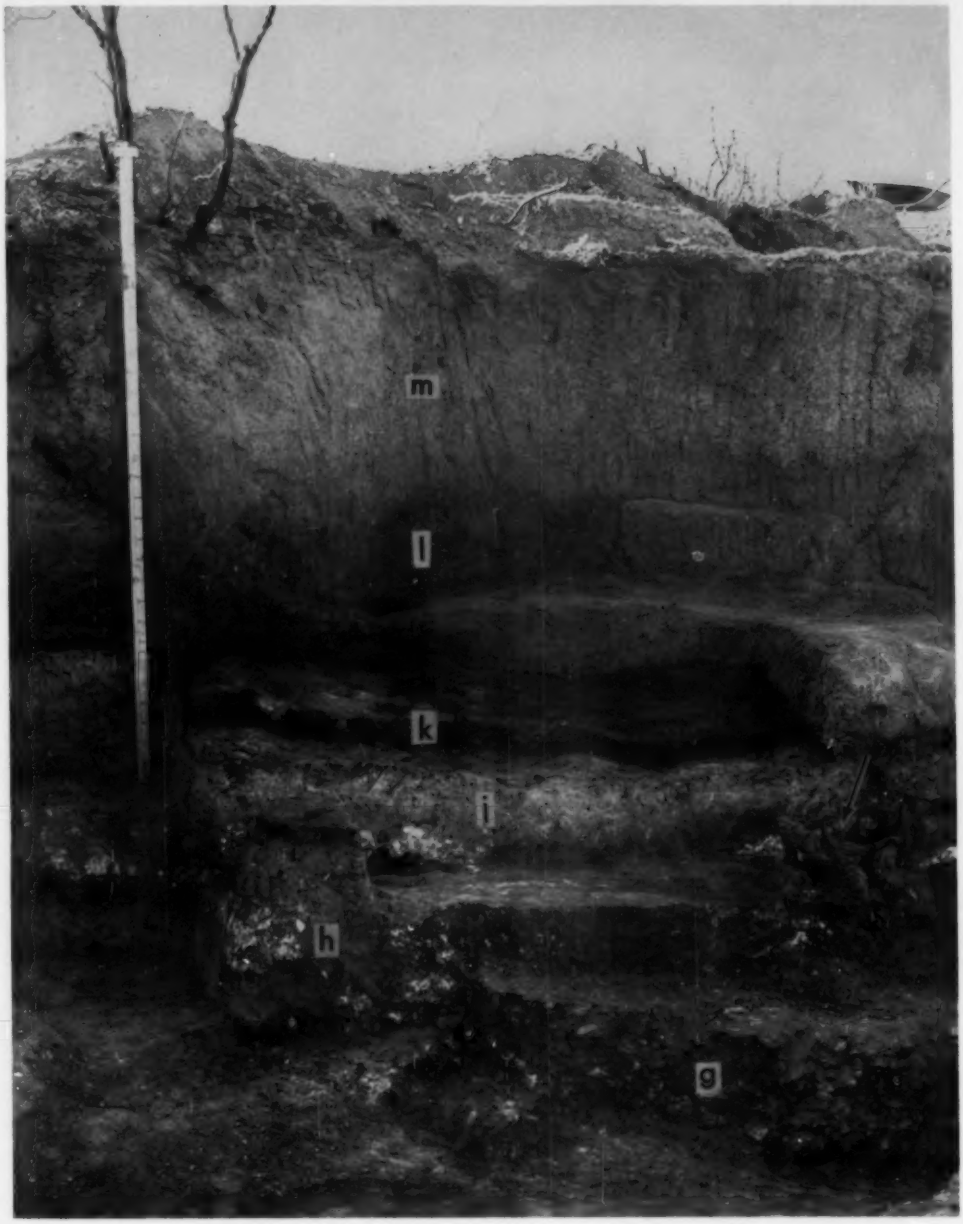

FIG. 10. Geological profile. See Figure 4 for key to lettered beds. Arrow indicates jaw of young mammoth. Scaling stick is 3 m. long.

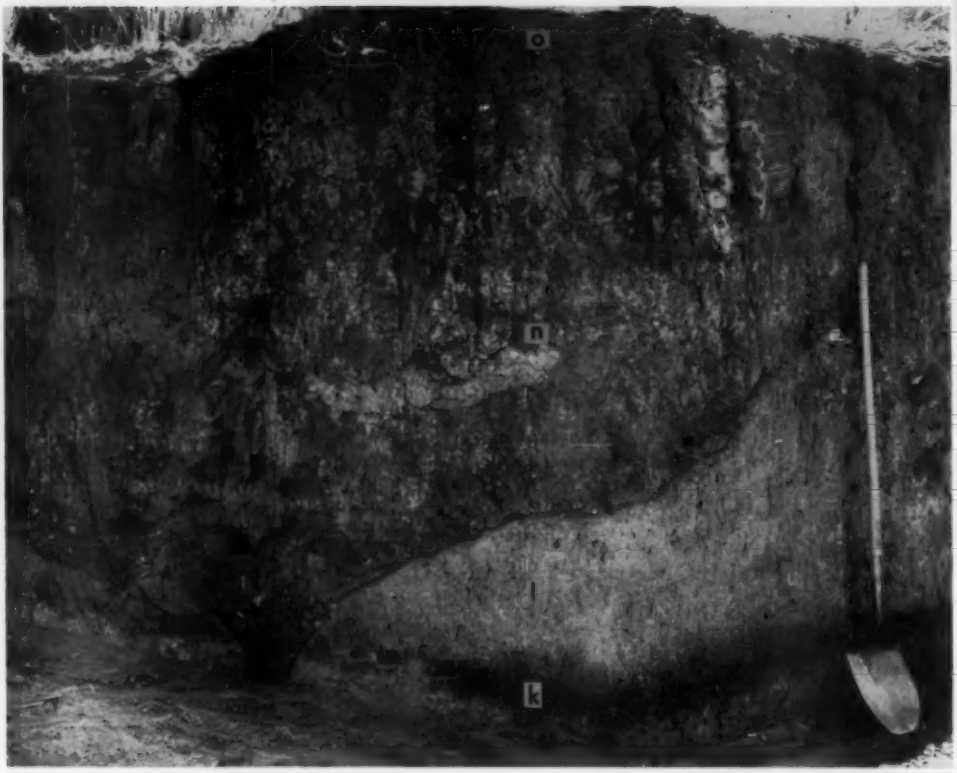

Fig. 11. Altithermal arroyo channel, cutting into black swamp soil, as exposed in modern arroyo 13 m. downstream from east end of excavation. See Figure 4 for key to lettered beds.

each are given in Table 1. All exhibit the same basic outline, oblanceolate with concave base. Minor variations range from essentially straight sides (Figs. 12 *c*, 13 *c*) to convex sides (Figs. 12 *m*, 13 *m*) to slightly concave near the base (Figs. 12 *i*, 13 *i*). The latter example approaches in form the Cumberland type of the eastern United States. This basal narrowing is barely discernable on several of the other examples in the collection. It seems to stem from the custom of dulling the edges by grinding. The maximum width on all occurs about midway between the point and the base. All intact bases are concave. The angle of inclination noted by Di Peso (1953a: 85) on the Willcox Playa and Texas Canyon points is a measure of unequal tang length. It does not appear to be a significant feature of the present sample.

The flaking on all points is horizontal and highly variable as to flake size. Fine edge retouching is observed on one point (Figs. 12 *j*, 13 *j*). The poorest control of the pressure technique is seen in the three small, clear quartz points (Figs. 12 *a-c*, 13 *a-c*) where it is attributable to the nature of the material. Only the three quartz points do not show fluting, though some basal thinning is apparent. Fluting occurs on both faces of the rest of the points. On the whole the flutes are short and sometimes flanked by short narrow flake scars along the margins at the base. Close study of the fluting suggests that no further edge chipping was done after making the channel. What can happen when a stone spear tip strikes bone is indicated by the point with tip missing and impact fluting extending from the tip baseward (Figs. 12 *m*, 13 *m*). It was found in contact with a mammoth ilium. Bases and edges, extending about one-third the distance to the tip, were ground smooth. This treatment was also accorded the fractured edges

of one point (Figs. 12 *f*, 13 *f*) from which a long sliver was broken. These two points suggest that retrieving of projectile points was practiced.

The size range of these points, from 31 to 97 mm., roughly duplicates the situation encountered in the Naco sample (Haury, Antevs, and Lance 1953: 7), underscoring the fact that there probably is no significant correlation between the size of a projectile point and the size of the game hunted. We think that the material source, clear quartz crystals, was the size limiting factor in the production of the three small points (Figs. 12 *a-c*, 13 *a-c*) rather than the kind of game to be hunted with them. One of these was found next to a mammoth pelvis and the largest of the three was wedged between ribs tentatively identified as those of a bison. It seems obvious that the makers of these points were strongly form conscious but not bound to any compelling size ideal. Recognition of this ought to reflect itself in our analytical treatment and categorization of projectile points.

The eight tools, other than points, may be functionally labeled as scrapers, a knife, and a chopper. Pertinent information about these is given in Table 2. The scraper category, accounting for five and probably six of the specimens, is the largest and best represents the tools associated with butchering. The implication here is that the larger scrapers may also have been equally useful as slashing and cutting tools. All scrapers are distinguished by unifacial edge chipping and a thick body. Form duplication suggests two types: pointed and keeled tools, steeply chipped along both edges (Fig. 14 *a, b*); and primary flakes with chipping principally along one edge (Fig. 14 *d, f, g*). The fragment shown in Figure 14 *c* undoubtedly fits here also. We have identified as a knife a primary flake (Fig. 14 *e*) the thin, naturally sharp edge of which bears small shallow chipping scars on one face. Whether these were intentionally made or were the product of shearing cannot be determined. The final tool is a stream cobble from which a few flakes have been detached (Fig. 14 *h*). These flakes were driven from the naturally flat side of the stone. It resembles simple chopper forms common in early sites of the Desert culture.

A few additional comments on the scrapers are in order. The similarity in size and form of the two pointed, keeled tools suggests that these represent a formalized type in the minds of the makers, designed to perform special and possibly heavy-duty work. The points were snapped off the remainder of the tool at the same places and by a force applied from the same direction. While these have not been reported heretofore as associates of Clovis fluted points, similar artifacts are seen in the preceramic horizons of the California desert (Campbell and others 1937, Pl. 33 *d*), southern Arizona (Haury 1950, Fig. 34 *f*), and interestingly enough in the possibly early site of El Jobo in northwestern Venezuela (Cruxent and Rouse 1956, Fig. 3). Tools labeled as side scrapers, distinguished by having a well developed point but lacking the keel, accompany the fluted points from both the Shoop site (Witthoft 1952, Pl. 2, *13, 15, 16*) and the Bull Brook site (Byers 1954, Fig. 92 *i*) in the eastern United States. These occurrences suggest that a pointed and keeled scraper form is not only early but may prove to be one of the diagnostics of the Llano complex. The other scrapers in the collection with side chipping are perhaps too generalized to permit comparison, since their form was largely determined by the shape of the original flake.

The real meaning of the tools other than projectile points from the Lehner site is that they begin to fill out the Llano or Clovis complex (Fig. 15) and provide us with some idea of the equipment used in butchering.

The identification of the rock types from which the points and other tools were made are listed in Tables 1 and 2. These determinations were made in the Arizona Bureau of Mines, University of Arizona, by microscopic study and spectrometric tests on materials believed to be identical with the rock type from which the artifacts were made. The chief interest in doing this was to determine if some of the materials could have come from distant sources. Since all materials used originated in either volcanic or sedimentary rocks and both of these are present in the area, it is probable that tool stone was local in origin. Raw material for the three crystalline quartz points probably came from the Huachuca Mountains where local deposits of sizable crystals are known.

NACO-LEHNER COMPARISON

Before leaving the discussion of the tools of the Lehner site, a few words are in order about the similarities and differences of the Naco and Lehner stations. It should be noted that the accident of discovery has allowed us to exhume within the span of a few years and from two places only 12 miles apart evidence bearing significantly on early man's activities. The two stations differ in that Naco yielded but a single animal while the Lehner site yielded numerous units both in animals and species. Only projectile points were recovered at Naco while Lehner,

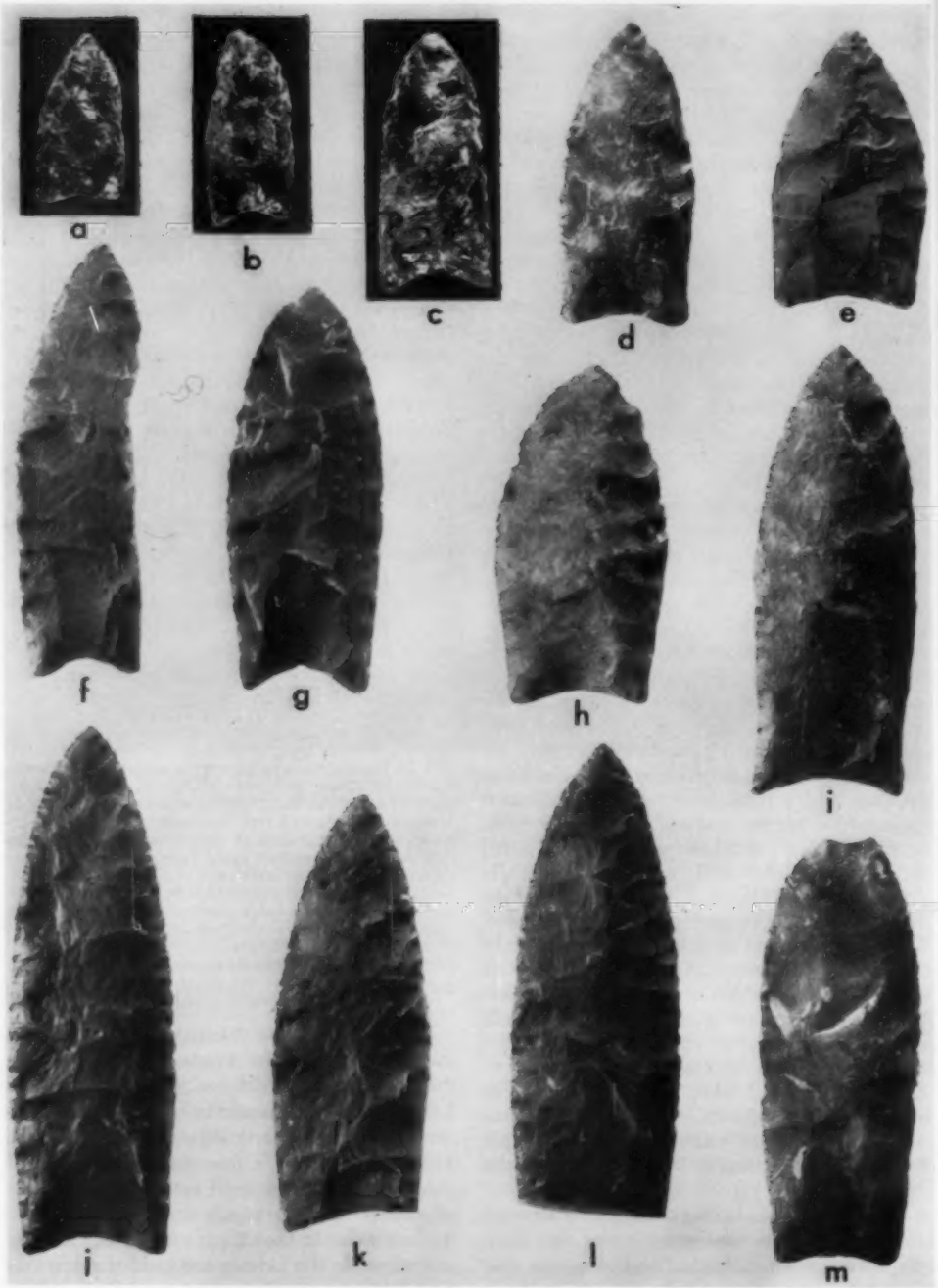

Fig. 12. The projectile points from the Lehner site. Length of *j* 97 mm.

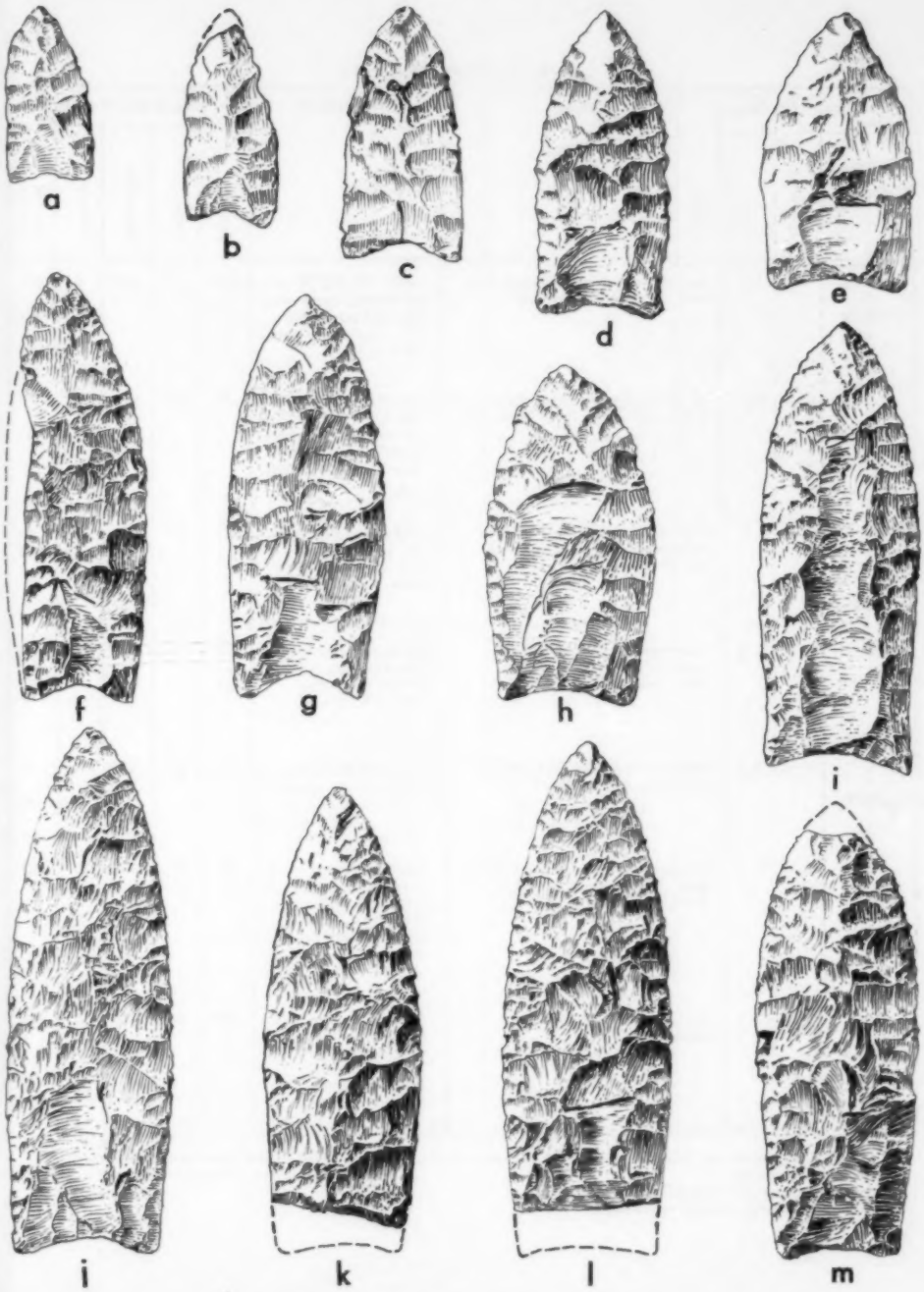

FIG. 13. Reverse faces of points illustrated in Figure 12.

TABLE 1: PROJECTILE POINTS

Specimen No.*	Fig. Ref.	Location	Description**	Measurements in mm.***				
				Length	Width	Basal width	Thickness	Extent of Basal Grinding
1 (A-12674)	12 l, 13 l	Tip near mammoth rib fragment in fine sand; .15 m. below swamp soil.	15-20 mm. missing. Chalcedony; translucent, very dark gray, 10YR, 3/1, clouded with black, 10YR, 2/1.	(87)	31	(27)	8	(22)
2 (A-12675)	12 f, 13 f	Tip against mammoth vertebral spine in fine sand; .10 m. below swamp soil.	Long splinter broken from side; slightly reshaped and corners of thick edge ground. Chert; opaque, dark gray-brown, 2.5Y, 4/2.	79	(22)	(19)	7	32
3 (A-12676)	12 j, 13 j	In gravel bar; .12 m. from bison jaw fragment and .05 m. from mammoth rib; .25 m. below swamp soil.	Chalcedony; translucent dark gray mottled with light and dark shades of brown, 10YR, 3/2.	83	29	27	10	43
4 (A-12677)	12 g, 13 g	Under mammoth rib fragment near center of bone bed in gravel bar; .25 m. below swamp soil.	Chert; translucent dark gray 7.5R, 4/0 with bands of darker gray, 5YR, 4/1.	74	28	23	8	28
5 (A-12678)	12 b, 13 b	Under mammoth ilium .25 m. below swamp soil, in gravel bar.	Point missing. Clear quartz.	(36)	17	15	7	12
6 (A-12679)	12 h, 13 h	Flat against distal end of mammoth leg bone; .15 m. below swamp soil in gravel bar.	Possibly reshaped. Chert; translucent gray, 2.5Y, 6/0, mottled with lighter and darker specks of gray.	62	31	25	8	29
7 (A-12680)	12 k, 13 k	In mixed clay and gravel; .05 m. below swamp soil.	About 15 mm. missing. Chert; opaque light brownish-gray, 10YR, 6/2 with a band of light gray, 10YR, 7/1.	(81)	29	(25)	7	(25)

* Listed in order of discovery. Numbers coincide with those shown in Fig. 4. Parenthesized numbers are Arizona State Museum catalogue designations.

** Code designations refer to Munsell Soil Color Chart.

*** Parenthesis indicates estimated measurement.

TABLE 1: PROJECTILE POINTS (Cont.)

Specimen No.*	Fig. Ref.	Location	Description**	Measurements in mm.***				
				Length	Width	Basal width	Thickness	Extent of Basal Grinding
8 (A-12681)	12 c, 13 c	Between ribs (? bison), .10 m. below swamp soil in mixed clay and sand near S. bank of Mammoth Kill Creek (see Fig. 5).	Clear quartz.	47	21	21	7	13
9 (A-12682)	12 d, 13 d	Flat against mammoth long bone; .20 m. below swamp soil in gravel bar.	Chalcedony; translucent gray, 10YR, 5/1, mottled with specks of pale red, 7.5YR, 5/4.	56	25	23	7	22
10 (A-12683)	12 a, 13 a	.15 m. from mammoth ribs; .40 m. below swamp soil in the gravel bar.	Clear quartz.	31	17	16	5	12
11 (A-12684)	12 m, 13 m	Tip touching mammoth ilium in mixed clay and gravel; .40 m. below swamp layer in area of deepest bone concentration; .30 m. north of mammoth jaw No. 4.	Tip impact fluted. Chalcedony; translucent gray, 7.5R, 5/1 mottled with dark gray-brown spots, 10YR, 4/2.	(78)	30	22	8	32
12 (A-12685)	12 l, 13 l	.10 m. from a mammoth vertebral corpus in mixed clay and gravel; .15 m. below swamp soil and .75 m. west of mammoth jaw No. 7.	Chert; opaque gray-brown, 10YR, 5/2 streaked light gray and red brown, 10R, 3/6.	97	30	26	8	35
13 (A-12686)	12 e, 13 e	.15 m. from mammoth jaw No. 5 in sloughed clay from south bank of Mammoth Kill Creek; .25 m. below swamp soil.	Jasper; opaque, pale red, 7.5R, 4/2.	52	28	26	7	22

* Listed in order of discovery. Numbers coincide with those shown in Fig. 4. Parenthesized numbers are Arizona State Museum catalogue designations.

** Code designations refer to Munsell Soil Color Chart.

*** Parenthesis indicates estimated measurement.

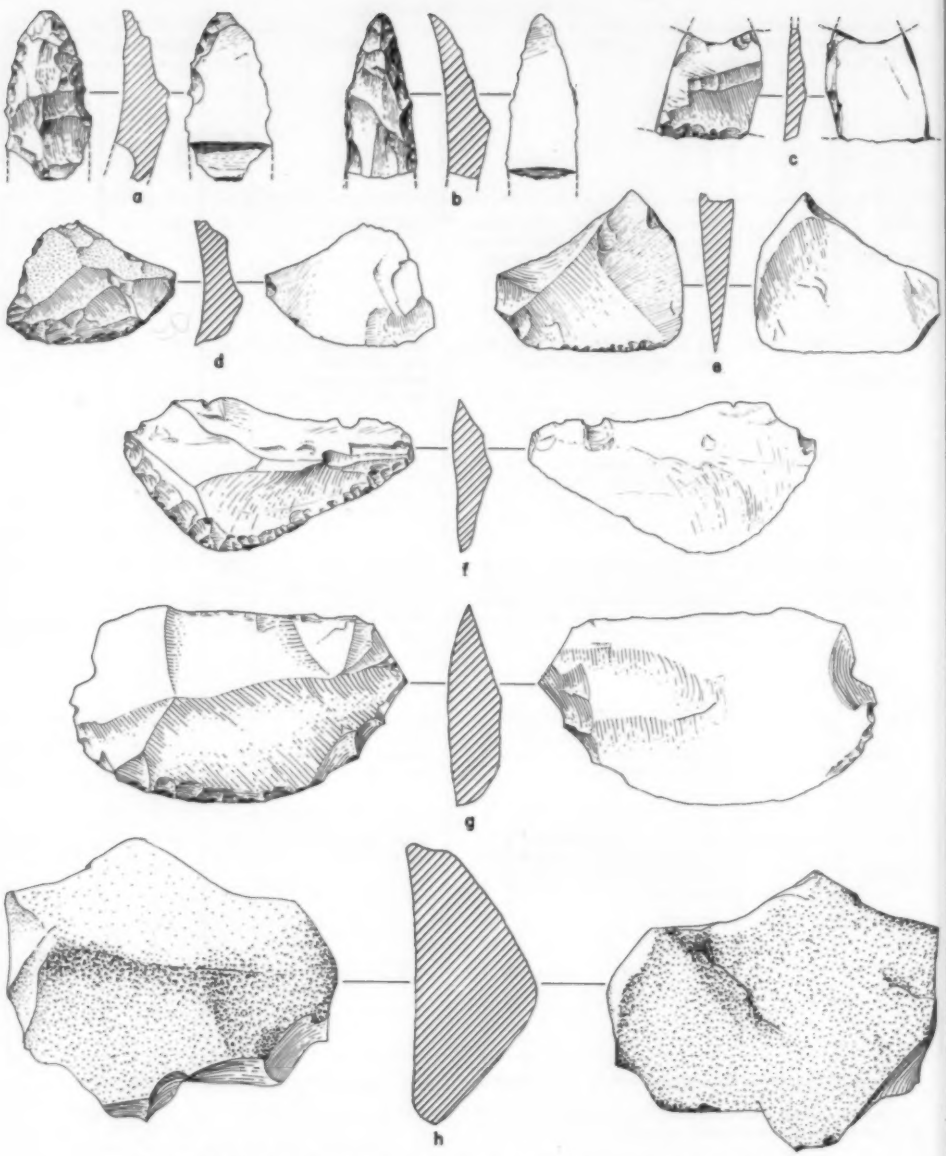

Fig. 14. Tools other than projectile points from the Lehner site. Length of g 130 mm.

TABLE 2: OTHER TOOLS

Specimen No.*	Fig. Ref.	Type	Location	Description**	Measurements in mm.***		
					Length	Width	Thickness
1 (A-12687)	14 d	Side Scraper	Beside mammoth leg bone about .15 m. below swamp soil in mixed sand and clay.	Chalcedony; translucent grayish-brown, 2.5Y,6/2, streaked with dark brown, 10YR,4/3.	66	46	16
2 (A-12688)	14 h	Cobble Chopper	Under mammoth tibia in gravel bar; .15 m. below swamp soil.	Natural pebble with at least three thick flakes removed by striking the same face. Rhyolite; grayish-brown 10YR, ranging from 5/2 through 7/2.	120	110	40
3 (A-12689)	14 f	Side Scraper	Under mammoth rib and next to proximal end of humerus of nearly articulated long bones; .30 m. below swamp soil in mixed clay and sand.	Finely retouched convex edge. Chalcedony; opaque, dark gray, 5Y,4/1, with clouds of dusky red, 10R, 3/3.	112	58	18
4 (A-12690)	14 c	Tool Fragment	Under mammoth vertebra fragment and .10 m. west of tip of tusk belonging to jaw No. 8; .25 m. below swamp soil in mixed clay and sand.	Fragments showing chipped edge. Andesite; gray patina, 5Y,6/1.	(35)	40	6
5 (A-12691)	14 a	Keeled Scraper	Under same mammoth long bone as point A-12682 but at the opposite end and .10 m. lower; in gravel.	Fragmentary; coarse flaking with some fine retouching. Chalcedony; translucent light gray 7.5R,7/10, mottled with specks of white, 10R,9/1, and weak red, 10R,4/4.	(65)	33	15
6 (A-12692)	14 g	Side Scraper	Near scattered mammoth teeth .30 m. below swamp soil in gravel bar.	Flake scars shallow, some fine retouching; edge dulled. Andesite; black, 7.5R,2/0.	130	73	20
7 (A-12693)	14 e	Knife	.40 m. below swamp soil in mixed clay and gravel.	Thin edge of flake finely retouched or sheared. Andesite; very dark gray, 7.5R,3/0.	70	60	12
8 (A-12694)	14 b	Keeled Scraper	West of the main area of bone concentration in base of fine sand lense on gravel bar; .15 m. below swamp soil.	Fragmentary; coarse flaking heavily retouched or sheared. Rhyolite; pale brown, 10YR,6/3, speckled with dark brown, 10YR,4/3.	(63)	28	15

* Listed in order of discovery. Numbers coincide with those shown in Fig. 4. Parenthesized numbers are Arizona State Museum catalogue designations.

** Code designations refer to Munsell Soil Color Chart.

*** Parenthesis indicates estimated measurement.

in addition, produced other tools and two hearths. The scattered, small charcoal flecks in the Naco matrix probably signal a fire in the vicinity of the kill. The projectile point similarity is impressive because the two lots could be merged into one typological assemblage. The geologic history in both localities is essentially the same, recording a similar succession of events of about the same time magnitude. The Lehner swamp soil, certainly a local phenomenon, is missing at Naco.

The date assignments are equivocal. Antevs originally placed the Naco kill between 10,000 and 11,000 years ago (Haury, Antevs, and Lance 1953: 17) but he has since revised the figure to 13,000 or more years. The radiocarbon date for Naco at 9250±300 is some 2000 years younger than the probable age of the Lehner site at more than 11,000 years ago. Notwithstanding these discrepancies, the artifactual evidence suggests that the same people, perhaps the same band, were responsible for the kills, and that the time separating the two occurrences may have been no longer than a few years. If, however, the dates noted above are correct, the time difference has an important bearing upon our concept of the elephant hunter's tenancy of this part of the Southwest and of the stability of his projectile point form. There is no way presently to settle this problem. Nonetheless, the two localities go a long way towards establishing elephant hunting as a pattern for a part of the Southwest in which such evidence has been lacking and gives strong hope that the camp sites will some day be found.

The Llano Complex

Sellards (1952: 17–46) recently consolidated the known data on certain artifacts which occurred in association with extinct animals, principally the mammoth, and called the assemblage the Llano complex. In addition to the main sites, largely limited to the southern High Plains, he also included the Naco station because it produced Clovis fluted points, the chief diagnostic element of the complex. Small, unfluted points, scrapers, hammerstones, and crude bone implements were also recognized as elements of the pattern. In all, the aggregate number of specimens is small, so small in fact that the evidence seems slim to support so basic a concept of an old elephant-hunting society. However, the age of the Llano complex, certainly older in the main than Folsom, and a wide geographic range, show there is something to the idea. Amplification of the complex by adding to the trait inventory, the discovery of camp sites in datable geological contexts, and the recovery of the bones of Llano man himself are pressing problems.

The artifacts from the Lehner site clearly come within the pattern of the Llano complex on the basis of the fluted points and the small unfluted points, the associated fauna, and the age of the remains. The pointed scrapers and the large side scrapers have not been exactly duplicated by the materials from other Llano complex sites but they may be taken as examples of tools representative of the assemblage. Herein, perhaps, lies one of the more significant contributions of the Lehner site to our knowledge of the period.

The consistency and the range of the Llano complex artifacts recovered up to now from mammoth-kill sites are shown in the sketches of Figure 15. Included for comparative purposes are the tools associated with the remains of two mammoths in the Valley of Mexico. Fluted points were not found here but the stations may be roughly contemporaneous with the kill sites in the United States. The implement yield from slaughtering grounds gives us an activity-selected sample and hence a one-sided view of the probable tool inventory. The bone tools from the Blackwater No. 1 (Clovis) locality are hints of a wider range of artifact type, as are also the hammerstones. The latter have particular interest because Sellards notes (1952: 42) these "may also have served the purpose of a grinding stone." Similar handstones are a characteristic trait of the Sulphur Spring stage of the Cochise culture (Sayles and Antevs 1941, Pl. 3, *a*, *d*). Further definition of this element in the Llano complex may prove to bear significantly on Llano-Cochise relationships.

On a tentative basis, it would appear possible to expand the Llano complex as to components and range by taking into account the materials recovered with Clovis points in surface sites, especially in the West, providing that no mixture of artifacts from different horizons is represented. Many of these occurrences have been summarized by Daugherty (1956), Jennings and Norbeck (1955), Wormington (1957), and others. Inspection of the large Campbell (1940) collection from near Tonapah, Nevada, would bear fruit. The wide-ranging distribution of the fluted point in the eastern United States, as at the Bull Brook (Byers 1954), the Shoop (Witt-

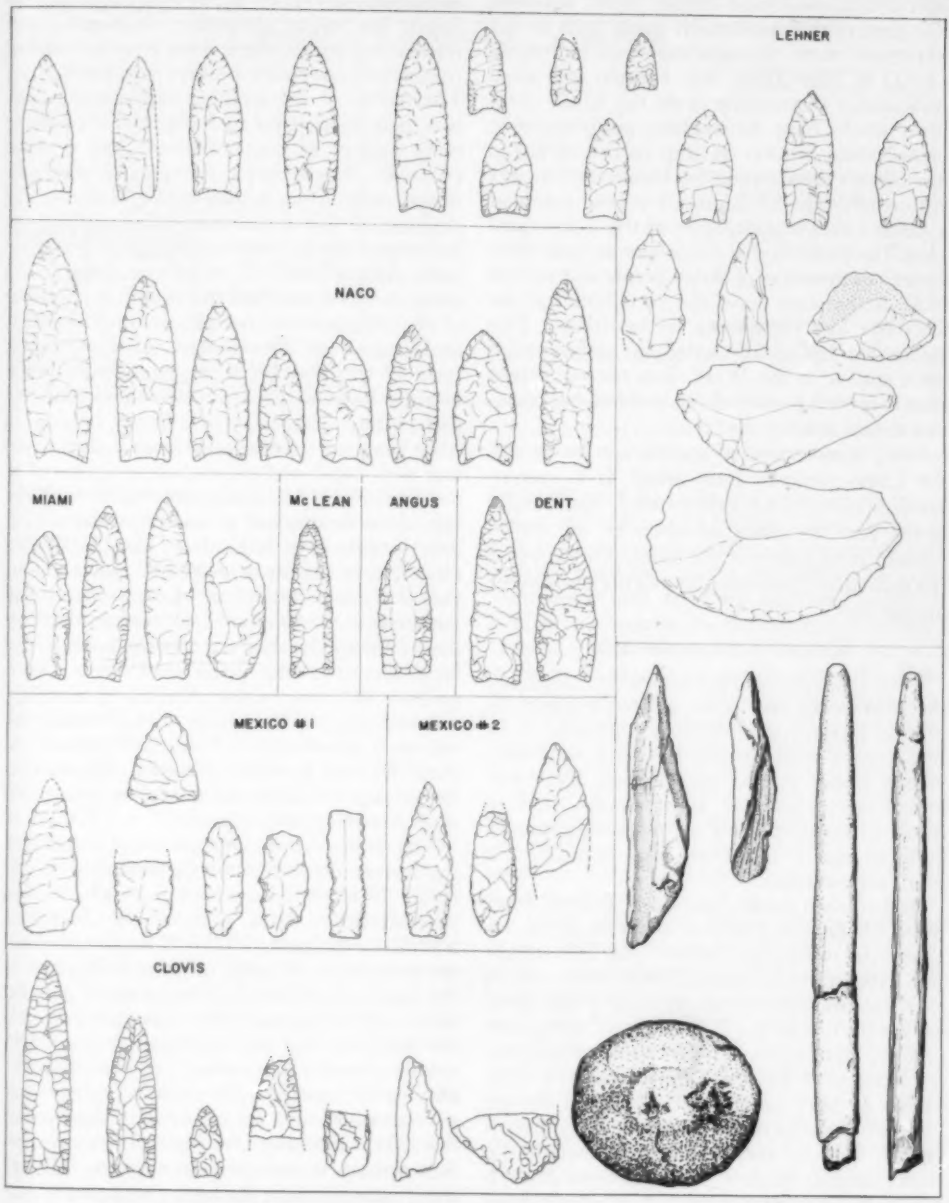

FIG. 15. The Lehner site artifacts compared with those from Naco and other sites which have produced tools in association with mammoth remains. Sources for artifacts other than those from Lehner site are: Naco — Haury, Antevs, and Lance 1953, Figs. 6, 7; Miami — Sellards 1952, Figs. 8, 9; McLean — Sellards 1952, Fig. 20 *b*; Angus — Figgins 1931; Dent — Figgins 1933; Mexico No. 1 — Martinez del Río 1952; Mexico No. 2 — Aveleyra Arroyo de Anda 1955, Pls. 25, 26; Clovis (Blackwater No. 1) — Sellards 1952, Figs. 13–18.

hoft 1952), the Quad (Soday 1954) sites and the surveys that have been made such as the impressive array of points examined by Ritchie (1957) in New York, once brought into some meaningful relationship with the Llano complex, would have far-reaching implications in paleo-Indian history. A step in this direction has already been taken by Mason (1958: 44) who regards the Michigan Clovis-like points as a Great Lakes manifestation of the Llano complex. The problem that exists here, as with other eastern occurrences of fluted points and related tools, is that they have not been found as yet with the late Pleistocene faunal forms. This association has greatly aided the definition of the complex in the West. It is not our intent here to launch a study of this problem but someone should attempt it.

Until a more unified picture can be drawn, the Llano complex must stand as a western manifestation. The Lehner and Naco increments may be taken to represent the southwestern most extent of the range. Both support the definition of the complex as a big game hunting pattern.

Dating the Lehner Site

Two methods for determining how long ago the mammoths and other animals fell prey to human hunters are presently available: estimates based on the geological history, and radiocarbon dating. Antevs' careful study of the geological record follows. It is not necessary to dwell on his report now beyond noting that he finds an age of 13,000 or more years for the event supportable.

Radiocarbon results have been obtained from three laboratories. Most of them are from the University of Arizona Carbon[14] Age Determination Laboratory (Wise and Shutler 1958), which then used the solid carbon method. Single dates each were run by the Radiocarbon Dating Laboratory, University of Copenhagen through the cooperation of Henrik Tauber, and the University of Michigan Phoenix-Memorial Project Laboratory through the assistance of James B. Griffin. Both of these laboratories employ the carbon dioxide method. The results are given in Figure 16. A review of the values reveals some disturbing internal inconsistencies as well as several gratifying correspondences.

Radiocarbon dates, as well as all other kinds of data, require evaluation in terms of reliability, consistency, and meaning. The present lot is no exception. Taking up the swamp soil (Fig. 4 *k*) results first we see altogether too large a range represented in the three dates from a thin bed to convince one that the assays were really good. The nature of the samples, carbonaceous soil, is suspect in itself for such material is probably more subject to contamination than is solid charcoal. Furthermore, these dates were obtained early in the history of the University of Arizona Laboratory and later refinements in the techniques are believed to have given better results. Antevs rejects the swamp soil dates on the grounds that these place the swamp in the onset of the Altithermal Drought, an improbability, and favors a late pluvial date. An argument in favor of this position is the stratigraphic relationship between the swamp soil and the bone and culture bearing layers directly below. In some instances the black layer was in direct contact with bones and everywhere it appeared to rest conformably upon the beds beneath. If the age of the swamp soil is correct at about 6700 years and the bone bed is dated some 5000 years earlier, then we must postulate either a long period of static conditions insofar as alluviation and erosion are concerned, or that an overburden of silt was washed off, exposing some of the bones just before the swamp developed. This is unlikely for some of the charcoal of Hearth 2 was imbedded in the swamp soil and locally the two were separated by a 1 cm. thick layer of fine sand. We are strongly inclined to believe that the swamp soil dates are much too young and should not be given credence.

The charcoal from Hearths 1 and 2 provided the laboratories with a nearly ideal kind of material. Nevertheless, at least three of the Arizona laboratory dates, 7205±450 for Hearth 1 and 7022±450 and 8330±450 for Hearth 2 are not acceptable. A span of some 5000 years in the assays of Health 2 charcoal alone goes far beyond the stretching ability of one's beliefs. No aboriginal fire was kept burning that long! Obviously something is wrong. The error in the above values can almost certainly be attributed to contamination of the charcoal. Realization of this led the laboratory technician to employ special methods to remove contaminants. The ensuing tests produced the higher figures of 10,900 ±450 and 12,000±450 with an average of 11,850 ±50. The independent measurements in the Copenhagen and Michigan laboratories, 11,180 ±140 and 11,290±500 respectively, are in convincing agreement between themselves and they

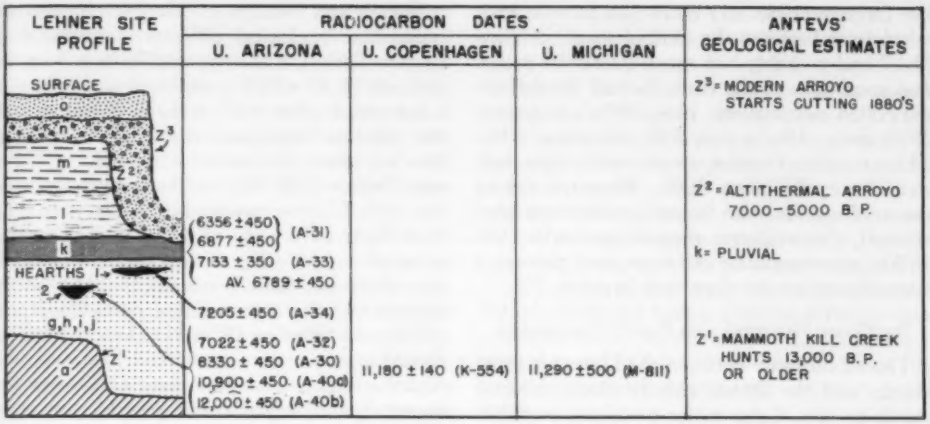

FIG. 16. Comparative results of radiocarbon measurements and Antevs' geological estimates. All radiocarbon dates are B.P. (1956–58). Beds not shown to scale; *b–f* omitted; *g–j*, the bone and artifact producing layers, not differentiated in drawing.

lend plausibility to the two older Arizona laboratory dates. It seems to us that a date of from 11,000 to 12,000 years ago for the time of the kills, is probably not far from the truth although this time range is short of Antevs' estimate.

The important question, of course, is how does an 11,000-to-12,000 year age correspond with such other evidence that exists for the dating of Llano man or the Clovis complex. The truth of the matter is that we haven't much evidence to draw upon and such as is available is contradictory. For example, Burnet Cave (Howard 1935) in New Mexico has yielded a radiocarbon date of 7432±300 (Libby 1955: 116) for charcoal from a level about 1 m. below a fluted point of Clovis type while the Lewisville site in Denton County, Texas (Crook and Harris 1958) which also produced a Clovis point has been dated in excess of 37,000 years ago by several radiocarbon assays. The Naco mammoth (Haury, Antevs, and Lance 1953) has now been dated by the radiocarbon method at 9250±300 (Wise and Shutler 1958: 72) and the four oldest Lehner assays from the three laboratories give an average age of 11,340 years ago. Three reliable measurements for the Bull Brook site on the eastern seaboard average about 9000 years ago (Byers 1959), a date which agrees well with the Naco date. However, the Burnet Cave, Naco, and the Bull Brook dates seem too young and the Lewisville date much too old for the Llano complex. In consideration of the generally accepted age of the Folsom complex at from 9000 to 10,000 years ago (Wormington 1957: 39) and the geological estimates we have, a date of 11,000 to 12,000 for Clovis points as seen at Lehner is reasonable. Antevs holds that both the Naco and Lehner sites predate the relatively warm and dry Datil Interval (12,500 to 10,800 B.P.) because the geology of both stations suggests a relatively moist, subarid climate, and therefore ought to be earlier than the Datil Drought. For many students of early man such an adjustment downward in time would be palatable. If the idea is accepted that the southeastern Arizona occurrences of the Llano complex are geographically marginal in its total distribution, then it may well be that the Lehner age assignment of nearly 12 millenia ago is a minimal date for a surviving manifestation of the complex.

Closely linked with dating studies nowadays is the information to be derived from fossil pollen. A spectrum of pollen taken from the sedimentary deposits of the Lehner site would undoubtedly yield significant information of paleoclimatic changes and provide added support for the age inferred from geology and more directly derived from radiocarbon. Although a liberal number of pollen samples were taken, the results of the analyses are not yet available. The principal work to date has been done by Lindsay (1958) centering upon the relative merits of three pollen recovery methods. Pollen was extracted from all geological horizons tested, including the artifact and bone-producing layers (Fig. 4 *g, h, i, j*). Systematic identification of the pollen grains has not been attempted,

but Lindsay (1958: 61) notes that Sample 11-1, taken from between the rami of mammoth jaw No. 7 and probably best representing the pollen rain conditions of the time, showed the following pollen distribution: pine, 39%; composites, 28%; grass, 4%; spores, 5%; unknown, 23%. These results, of course, are so slender that little weight may be given them. However, taking the geology and the faunal assemblage into account, the evidence suggests somewhat less aridity, an abundance of forage, and perhaps a lower forest border than now prevails.

Big Game Hunters and Plant Gatherers

The relationship between the Llano big game hunter and the Desert culture plant collector stands as one of the major problems of paleo-Indian history. The Lehner site contributes little towards its solution directly. But indirectly, because it is the second kill site in the San Pedro drainage, the original Naco discovery is lifted, at least part way, from its apparent out-of-context situation and the two together may be taken as a reflection of a well-established hunting tradition where it was unknown previously. Southeastern Arizona ought to be joined to the larger big game hunting territory that stretches far to the east and north. In the whole of this area, only the southwestern fringe, specifically southeastern Arizona, yields the abundant traces of the Cochise complex as well as those of the Llano complex. It is the presence of these two divergent tool patterns that confronts us with a provocative situation. Does this mean there was an orderly historical development from hunting to gathering? Or was it the penetration of hunter into gatherer territory; the submergence of the hunter by newly arrived collectors; or merely the shift in emphasis, perhaps seasonal or over longer time, from hunting-gathering to gathering-hunting by the same people? Or is the contrast between the two tool assemblages from which we infer different ways of life overemphasized (Willey and Phillips 1955: 733)?

The meaning of this transition is only slightly less significant for the New World than was the advance from food collecting to food producing in the Old World, for it was the dependence on plants, the knowledge about them, and the development of related grinding tools, that ultimately made the acceptance of agriculture and the settling down to village life easy. Several explanations have been suggested.

Willey and Phillips (1955: 732) have minimized the typological difference, classing both in their Early Lithic stage and leaving open the question as to which complex is the older. In a later study they hold that the dates for both the Sulphur Spring and the Chiricahua stages "are no longer too early for Archaic" (Willey and Phillips 1958: 91) and by implication view the early Cochise manifestations as later than their Early Lithic. As an aside, their reasoning is based on the allegedly questionable association of extinct fauna with the Sulphur Spring horizon and the occurrence of Pinto-like points (Willey and Phillips 1958: 91). Lest these ideas should gain currency, we would like to set the record straight. Part of a skull and other elements of a mammoth were imbedded *in* pond beds *overlying* the culture bearing Sulphur Spring layer at Double Adobe (Sayles and Antevs 1941: 47). Furthermore in the latter deposit, amongst the Sulphur Spring artifacts and hearth stones were the bones of horse, bison, pronghorn antelope, dire wolf, coyote, and mammoth (Sayles and Antevs 1941: 12). This determination is not based on a single occurrence in one site of this period but upon repetitive evidence in several sites. As for the Pinto-like points, a detailed geological study of their provenience makes it clear that they must be attributed to a somewhat later period than the Sulphur Spring stage (Sayles and Antevs in preparation). In short we believe that the Sulphur Spring horizon does occupy a relatively early time position, before the extinction of the late Pleistocene fauna, and that the basic question put earlier with respect to Llano-Clovis relationship cannot be settled on the premise of presumed lateness for the latter. However, it is possible to arrive at essentially the same conclusions as those reached by Willey and Phillips, but by a somewhat different route.

A point of view directly opposite to that held by Willey and Phillips was taken by the 1955 archaeological seminar group which stated ". . . that the technology of the Desert culture (of which the Cochise complex is a regional manifestation) is sufficiently distinct from that of the Paleo-Indian big-game hunter to testify not only to a quite different environmental adaptation but to a different cultural outlook as well" (Jennings 1956: 71). Moreover, because the indicated age of the Desert culture in the Great Basin is of about the same magnitude as that for the Llano complex, the seminar con-

cluded: "The older view, that the seed-using cultures similar to Cochise, were late developments out of a big-game hunting base, no longer seems tenable" (Jennings 1956: 71; 1957: 282). It was further held by the seminar group that if such a developmental sequence were the true state of affairs, the divergence took place far back in time, possibly even before man's entry into the New World.

Krieger (1953: 243) and Haury (Haury, Antevs, and Lance 1953: 13–14) have suggested that the transition was a logical succession following the disappearance of the game during the Anathermal warming. The change was ecologically bound and it was an enforced adaptation, if the society was to survive. This does not agree with Antevs' assessment of the geology but the idea, we feel, cannot be ignored.

Insofar as our immediately local problem is concerned, there are some arguments in support of big game hunting as a cultural stage antecedent to the collecting stage. Briefly these are:

1. The oldest radiocarbon dates for the Sulphur Spring stage are in the order of 7000 to 8000 years (Libby 1955: 112; Wise and Shutler 1958: 74) as against the substantially higher age of 11,000 or more years for the Clovis assemblage at the Lehner site.

2. The tool types of the Lehner site, especially the fluted points and the keeled pointed scrapers, have no equivalents in the inventory of Sulphur Spring stage tools. The base of a point resembling the Clovis type from a Chiricahua stage *context* (Sayles and Antevs 1941: Pl. 11 *a*) is an exception but it may be presumed to be so much later that it would appear to have no significant bearing on this argument. The failure thus far to find diagnostic tools of the two traditions mixed in the same site strongly hints at a temporal difference.

3. Once grinding utensils and the other tools needed to collect plant foods were developed or acquired, the stage was set for the long survival of the tradition. Undoubtedly hunting was still important in the economy, but such hunting as was practiced was not done with weapons carrying tips of the fluted lanceolate blades of the big-game hunter.

Perhaps this is drawing the obvious conclusion. In so doing no claim is made that the transition was initially centered in southeast Arizona and that it reflects, blanket-fashion, what happened broadly in western America. Our concern now is only with a local phenomenon. We estimate that the change in emphasis from hunting to collecting began before the complete extinction of the big game, witness the mammoth overlying the Sulphur Spring stage horizon in the Double Adobe station. In the post-glacial time table this was probably during the Anathermal, between 7000 and 5000 B.C. In fairness to another point of view, it must be noted that Antevs prefers the interpretation that the relatively warm and dry Datil Interval (12,000–10,800 B.P.) eliminated the mammoth (see Haury 1958a and Martin 1958 for different views on extinction). In this event the transition in economic dependence from meat to plant had to be made much earlier than has been postulated.

DISCUSSION

Two erosion periods, resulting in the Altithermal arroyo channel and the modern one, have combined to destroy a part of the bone bed. How much was washed away cannot be estimated accurately, but perhaps as much as 50%. Even so, enough has survived to make it clear that the bones of four species of animals, mammoth, horse, bison, and tapir, and at least nine individual mammoths, were present. This situation evokes a number of questions: Were all of the animals in the deposit killed by man? Were they all killed at once? If not, over what period of time were the bones accumulating? Why were the bones of so many animals restricted to such a small area?

Artifacts associated with skeletons of more than one animal are reported from the Miami locality, Texas, and Blackwater No. 1 locality in New Mexico (Sellards 1952: 18–31). Hence the Lehner ranch occurrence is not unique. In all of these instances the mammoth was the predominant animal, and only at Lehner and Blackwater No. 1 were horse and bison also present. There is at present no way of settling the question as to whether or not man was responsible for the demise of all the animals in these stations. It is well known from paleontology and by observing watering places for cattle today, that animal carcasses accumulate in limited areas without man's intervention. As for the Lehner site, judging from the artifact distribution, the presence of butchering tools, and the evidence of fires, it may be inferred that the majority, if not all, of the animals were slaughtered. Another strong argument for this is Lance's identification of all mammoths as either calves

or young adults. This age selectivity surely was no accident. It is explainable on the basis that the younger animals would be easier to isolate from the herd, easier to kill, and tastier. The older animals, those more apt to die of natural causes, are lacking.

We incline toward the idea of killing at intervals for the following reasons:

1. It is doubtful that so many animal units, including four species, would have been watering or congregating in the same spot at the same time and that hunters could have dispatched so many at once. Large mammals, except when herds are driven over cliffs, are usually taken singly.

2. Wide bone dispersal for some animals and less for others, with some articulation present, argues for spaced kills.

3. Unequal preservation of the bones due, possibly, to differential exposure.

4. Perhaps the most significant evidence in support of this view is the vertical distribution of the bones, as well as some artifacts, in the gravels of Mammoth Kill Creek. This depth range was approximately 1 m. While gravel and sand deposits may accumulate rapidly in strong current conditions, it did not appear probable, as the bones were removed from the matrix, that this was the case. The impact-blunted point (Figs. 12 *m*, 13 *m*) was found well down in the gravels next to the pelvic bone which it may have struck. Other flat-lying bones with closely related weapons were in higher levels. Upon completing the excavations we were left with the impression that here was a favored hunting spot where animals, attracted by water, were periodically ambushed and killed by the same band of people, but perhaps within a year's time.

When it became evident that more than one animal was represented in the bone bed, the question arose as to how and why this massing of bones came about. How were the animals contained? Was there a natural trap into which they could have wandered only to be slaughtered? The geomorphology of the station makes it clear that there was a sand and gravel floored stream bed bordered on the south by a nearly vertical bank of red clay about 1.8 m. high. The nature of the north bank is not known since it was destroyed by the Altithermal erosion. One must imagine that the animals, attracted by the water, drifted to the deepest part of the stream. This was along the outside curve of a meander bow against the clay bank. The walls of the channel, and the slopes away from them may have been too high and too slippery to be negotiated by mammoths, and access to the favored watering spot was either up or down the stream bed where trails led into it. Escape routes would have followed paths of access. At this point man probably entered the picture, for, having seen animals at the water hole, he was able with the aid of firebrands or noise, or by virtue of numbers, to contain the beasts in the channel long enough for hunters to select their prey, a young animal, and move in for the kill.

The feasibility of holding elephants at bay is demonstrated by the Nama Hottentots who, by hunting in large parties, surround the animal and repeatedly attack it from the rear as it turns against each new assailant until it falls, wounded and exhausted (Murdock 1934: 481). The use of pitfalls and spearing from trees appear the less likely techniques in the present situation.

After an animal had been felled in the stream or at its edge, butchering proceeded on the spot. In time, following repeated hunts, a considerable number of bones accumulated. The work of scavengers and the trampling of bones by animals tended to scatter and break them. Left as evidence of man's part in the drama were such projectile points as he did not retrieve, the broken ones and some others that escaped him, butchering tools perhaps regarded as expendable, and the remains of fires where choice morsels were roasted on the spot. It should be noted that the tapir jaw was within a hand-span of one of these hearths and slightly charred. This, of course, is sheer speculation, but it is one way of explaining the massing of the bones. We are sorely in need of long range observations around water holes, as in Africa, to see what happens to carcasses after complete abandonment by man and scavengers. Such data might help to explain the situations encountered in the kill sites of early America.

In the preceding reconstruction, containment of the animals within the geographic area of their wounding around a water hole is implied. This seems also to have been the case at Naco, Miami, and Blackwater No. 1 localities. These places evidently did not have the physiographic advantages offered by the Lehner site, which leads to the suspicion that the primitive hunting techniques are a long way from being understood. African elephant hunting provides contrasts to this containment method. The African

pigmy smears himself with mud from the water hole frequented by elephants and with skill and courage, creeps underneath the beast to thrust his spear deep into its belly. Then follows the arduous trailing of the animal until it perishes from its wounds (Janmart 1952: 146–7). In "The Hunter," John Marshall's film of a Bushman giraffe hunt in the Kalahari Desert, the animal first received an arrow treated with slow-working poison. Trailing extended over a six-day period and many miles before the animal, in its stupified condition, could be brought down. There is no evidence that poison was used by the early American hunter, but he seems to have had considerable success in the difficult task of holding a wounded animal close to the spot where it was first encountered.

As noted earlier, the range in projectile point length is large, from 31 to 97 mm. That the smallest points, all of quartz (Figs. 12 *a-c*, 13 *a-c*), should have been used to fell mammoths seems improbable. But, since many of the mammoths were calves, the contrast between weapon and animal size is no greater than it was later when the Folsom point was used against the bison. Figure 5, showing a small quartz point lodged between ribs of a young mammoth (?) seems fairly conclusive. Nevertheless, the size range of the Naco points, found with a single mature animal (Haury, Antevs, and Lance 1953: 7), argues for the fact that the primitive hunters did not restrict spears with small tips to small game.

Our knowledge of butchering methods is as vague as is our understanding of hunting techniques. Fortunately, the Lehner site, more than any other to date, has given us tools whose function must have been that of cutting up the animal. The large scrapers or knives (Fig. 14 *f*, *g*) would have served well for this, as would also a fluted point itself. The fragments of two keeled, pointed scrapers (Fig. 14 *a*, *b*), snapped off at the same distance from the point and by a force coming from the same direction, evidently were special purpose tools designed for heavy work of unknown character. Beyond the recovery of flesh and hide, there is a hint that skulls were crushed for brains. Masses of smashed brain case bones were found, but no whole skull survived. This practice has previously been noted at the Iztapan mammoth finds (Aveleyra Arroyo de Anda 1955: 17–18).

Speculating once again as to how the meat was handled, it would appear that dismembering a large animal was a task of major proportions, both because of the difficulty of severing limbs and the weight of the units. In the young animals this might not have applied. The meat was most likely removed from the animal by chunk, strip, or roll, the method used by the historic bison-hunters in the Plains. This type of removal facilitated transportation of the meat to camp and doubtless was necessary anyway to preserve it by drying, a technique which must surely have been known long ago. This method of butchering would leave the skeletons intact.

In another place (Haury 1958b) attention has been called to the possible importance of the difference in the butchering techniques employed by the Old and New World big game hunters to account for an anomolous situation of preservation in these two regions. In America a large percentage of the evidence of early man has come from kill sites (Wormington 1957). The Lehner site must be added to the ever-growing list. For Europe, however, with its infinitely longer record of the Paleolithic and probably greater population density during all stages, references to kill situations are almost non-existent. Only two documented instances have been found, the first a Third Interglacial mastodon skeleton with an associated wooden spear shaft in Germany (Movius 1950), and the second, the bones of a young mammoth with related hearth stones and worked stones found in western Siberia outside the city of Tomsk (Movius 1950: 141, footnote). In Paleolithic camp sites, however, bones of extinct animals are of common occurrence. Paleo-Indian camps in America also produce bones of extinct animals but thus far representing principally bison. To explain the contrast in the frequency of kill stations one must believe that in Europe they have not been found or not reported, or that glacial activity has reduced the chances of discovery if kill stations were present, or else one must believe that the difference is a significant one. If the latter situation is correct, and at the moment it seems the most plausible, then a reasonable interpretation is that the American hunter removed the meat from the carcass for transport to camp, whereas the European hunter may have dismembered the carcass, carrying the segments, including bone, away. Few traces of the kill would survive if this were the case.

Conclusions

The evidence presented in this and the following two papers permits these conclusions:

1. The remains of nine Columbian mammoths and at least one animal each of horse, bison, and tapir, occur in a single bone bed on the Lehner ranch in southeastern Arizona, in and on the gravels of a fossil perennial stream bed.

2. Directly associated with the bones of these animals was evidence of man's pursuit and destruction of at least some of them: 13 spear points of the Clovis fluted type, eight cutting and scraping tools, and the remains of two fires.

3. Subsequent to the killing of the animals, the formation of swamp soil and then heavy alluviation concealed the bone bed, followed by the cutting of an arroyo (Altithermal) which destroyed an indeterminate part of it. Further alluviation filled this channel and elevated the local ground surface to its present position. The modern arroyo has exposed the preceding events in its banks.

4. The episodes enumerated constitute the basis for the geologic dating of the site to a time of 13,000 or more years ago. Radiocarbon measurements place the time of the kills between 11,000 and 12,000 years ago.

5. The implement typology identifies the hunters as related to the big game hunting Llano complex best known from the High Plains.

Arizona State Museum
Tucson, Ariz.
December, 1958

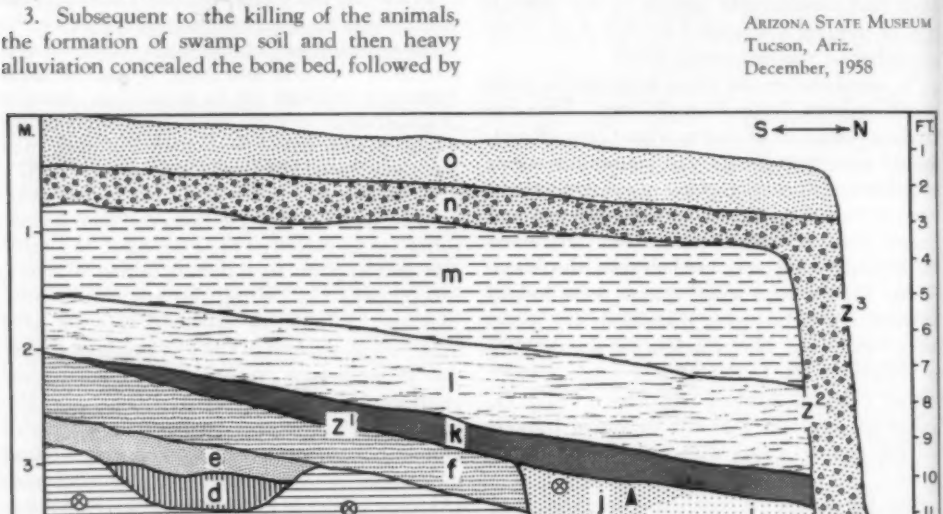

Fig. 17. Composite south-to-north profile of the site of the mammoth hunt at the Lehner ranch. Z^1 marks the old stream channel in which bones and artifacts were deposited. Z^2 indicates the Altithermal, and Z^3 the modern arroyo.

GEOLOGICAL AGE OF THE LEHNER MAMMOTH SITE*

ERNST ANTEVS

ABSTRACT

The late Pliocene basal clay of the region and remnants of later deposits are cut by a perennial stream of pluvial age. Bones and artifacts, including Clovis fluted points, occur in gravel and other channel deposits in a meander bow of this stream. The bone bed is overlain by a black swamp deposit indicating a subhumid climate and by calichified silts indicating arid conditions, both cut by an Altithermal channel. The hunt, stratigraphically pre-Altithermal, is dated by the equation of the relatively warm and dry 14-to-12 foot level in the San Augustin Plains profile with the Alleröd of northern Europe (12,500–10,800 B.P.). This semi-arid period, called the Datil Interval or Datil Drought, is believed to have caused the extinction of the mammoth in both the Southwest and the High Plains by 11,500 B.P. The Sulphur Spring stage Cochise deposit at Double Adobe, which is overlain by a bed containing a mammoth skull, is dated at more than 12,500 B.P. The mammoth hunts of the Lehner and Naco sites are assigned an age of 13,000 or more years.

THE BASE FORMATION at the Lehner Mammoth site is a red-brown clay with soft white caliche, resembling the substratum at Double Adobe (Sayles and Antevs 1941: 46), 24 miles to the east. This red clay, Bryan (1926) found, was deposited in the central areas of the original valleys, and is completely surrounded in the San Pedro valley by its marginal correlative, the Gila conglomerate. Mammal bones in the red clay have been assigned to the late Pliocene (Gidley 1925). In the site the eroded surface of the red base clay (Fig. 17 *a*) is overlain by a series of beds all of which have been reduced to remnants by interdepositional erosions. The beds are in order of formation: olive colored clay with bones (Fig. 17 *b*), reddish calichified clay with lenses of sand and fine gravel and with bones (Fig. 17 *c*), gray clay (Fig. 17 *d*), reddish silty sand (Fig. 17 *e*), and gray calichified clay with lenses of silt (Fig. 17 *f*). The alternation of deposition and erosion was presumably induced by climatic changes.

MAMMOTH KILL CREEK AND ITS DEPOSITS

In comparatively late times a stream (Mammoth Kill Creek) cut through these older beds into the base clay. The eroded channel, whose south bank was practically perpendicular (Fig. 17 Z^1), was about 1.8 m. deep. Since the north bank has not been found, the width of the stream channel is unknown but is assumed to have been about 3 m. (Fig. 18). The observed part of the south bank of Mammoth Kill Creek, which is drawn with solid line in Figure 18, formed the outer side of a bow which was sharply bent at the downstream end. Geologic profiles through the bone bed and west of it show coarse gravel (Fig. 17 *g*) covering the channel floor in its entire probable width. At the sharp bend the gravel does not extend to the south bank but interfingers with red-brown clay containing caliche lumps and stream-brought pebbles (Fig. 17 *h*). This clay may have mainly slumped from the bank because of undercutting, but may in part have been brought a short distance by the stream. The gravel is superimposed by pink and white sands (Fig. 17 *i*). The talus clay at the south bank is overlain by sand which grades upward into silt and clay (Fig. 17 *j*). It was in the upper 1.2 m. of these channel deposits, in the talus and in the gravel, sand, silt, and clay, that the artifacts and the mammal bones, mainly of mammoth, occurred.

The observations suggest that the old channel was part of a meander bow. In this bow the filling proceeded at a faster rate at the inner north bank than at the outer south stream bank, so that in cross section the water depth increased towards the south bank. As the upstream end of the bow became partly blocked by deposits, fine-grained mud could settle in the south-side portion of the channel. While these conditions prevailed the mammoths, impeded by the sticky clay and the steep south bank, fell prey to the ancient hunters. Later, during a flood, the stream may have overflowed the meander neck and eroded a cutoff (Fig. 18). The old channel was thereupon filled. Since there now was no sheer bluff, the site was no longer a mammoth trap. The old stream trench was not an arroyo, for natural arroyos are cut when the climate has just turned arid after having been semi-arid (Antevs 1955: 318), and an arid climate could not have

* Most of the observations, serving as bases for the composite profile (Fig. 17) and for the course of the stream at the time of the hunt (Fig. 18), were made by W. W. Wasley.

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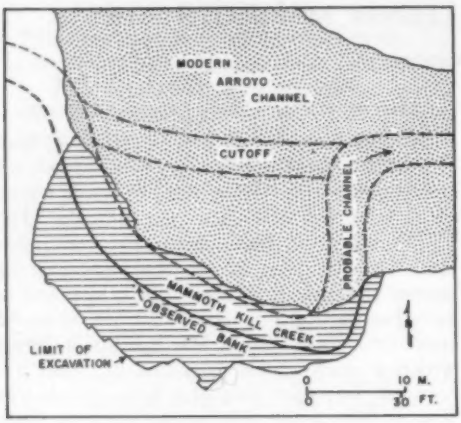

Fig. 18. Probable course of the pluvial stream channel (Mammoth Kill Creek) at the time of the mammoth hunt.

produced a vegetation adequate to support the mammoth. This inference and the swamp, described below, show that the old channel was cut by a perennial stream of a pluvial age.

Black swamp soil. The channel fill and the old south bank are overlain by a black bed, 5–25 cm. thick (Fig. 17 *k*). This layer, Theophil F. Buehrer, Professor of Agricultural Chemistry, University of Arizona, informs us, is a silty clay loam and represents a portion of the A horizon of a swamp soil. Thus, after the channel had become filled, a cattail and tule swamp developed and extended 6 to 8 m. south of the channel and rose on the sloping ground as much as 1.5 m. The swamp spread more than 45 m. in west-east direction. Occasional flood brought silt, sand, and clay into the swamp. This layer directly overlies charcoal in the hearths and mammoth bones. It evidently began forming directly upon the filling of the stream channel, before the charcoal was dispersed by water and wind and before the bones disintegrated.

Postpluvial beds. The black soil is directly overlain by 45 cm. of gray silt which is firm, clayey, and calichified (Fig. 17 *l*). This in turn is superimposed by 1.2 m. of relatively loose silt of light gray to light tan color (Fig. 17 *m*). Above an erosional disconformity, presumably of Altithermal age, is a bed, 30 cm. thick, of a firm red-brown mixture of silt, sand, clay, and pebbles (Fig. 17 *n*). The top bed (Fig. 17 *o*) consists of 45 cm. of silt, dark gray from organic matter.

The Age of the Hunt

The presence of mammoth and the swamp soil (Fig. 17 *k*) show that the small tributary stream was perennial, and that the region supported an abundant vegetation. This probably consisted of a dense ground cover of grasses between and under widely spaced trees, an oak woodland-grassland. The climate may have been dry subhumid or slightly moist subhumid in Thornthwaite's (1941: 3; 1948, Pl. 1) classification. The San Pedro River was a perennial stream of fair size. So moist a climate has not prevailed in the region since the last pluvial. The pluvial age of the black soil and subjacent channel beds (Fig. 17 *g-j*) is also shown by the presence of caliche in the directly overlying bed (Fig. 17 *l*), for the caliche may have accumulated during the Altithermal Long Drought. On the southern High Plains the mammoth became extinct comparatively early, for it is associated with the Clovis Fluted point, but not with the Folsom point (Sellards 1952: 17, 115). Therefore the mammoth hunt at the Lehner ranch took place during the pluvial; the problem is how far back in the pluvial, how long ago.

The present discussion will be based on the fair assumption that the mammoth required a distinctly moister climate than now prevails in the Southwest, so that the earliest late or postpluvial drought that approached without attaining the severity of the modern drought exterminated him in the region. This calls for an appraisal of the relative intensity of the droughts since A.D. 1870 and of those past ones which induced natural arroyo cutting by reduction of the vegetation mat. In my opinion the current drought would perhaps cause natural arroyo trenching now, at least in southern Arizona, for in the Gila River basin we experienced in 1956 the cumulative effects of the severest drought since the late 1200's (Schulman 1956: 67), the latest prehistoric drought to cause known arroyo erosion in Arizona. On the other hand, the modern arroyo cutting, which began largely during the 1880's, was, I believe (Antevs 1952), caused by drastic destruction of the vegetation by white man and his domesticated animals. Scanty precipitation and high intensity rains were probably contributing factors (Schumm and Hadley 1957: 162), but climatologically the problem is whether the drought alone, under natural conditions, without man and cattle would have so reduced the plant cover as to induce arroyo trenching. The answer is negative.

for the erosion would have begun rather early in the dry cycle, which in Arizona and New Mexico started in 1870 or 1871 and attained its greatest intensity in 1893 to 1904 (Schulman 1956: 64, 67, 111, 115). If the arroyo cutting of the 1880's had been drought-induced, there would be evidence of many more arroyo erosions in the past than are actually observed. Also, as we have witnessed during the past few years in Arizona, the native vegetation succumbs first to the cumulative effect of several years of intensive drought and then only gradually, branch by branch in case of some shrubs and trees.

In northern Europe the general late glacial temperature rise may have begun, as Joakim Donner has pointed out, with the Alleröd age, which was followed by a transitory temperature drop, the Younger Dryas or Salpausselkä age (Antevs 1953: 203). In Magnus Fries's temperature graph, dated by varves and plant pollens, the temperature increase began about 12,500 and the Younger Dryas 10,800 years ago (Antevs 1955: 323). In Denmark the comparatively warm Alleröd has been radiocarbon-dated at about 12,000–10,800 B.P. (Iversen 1953: 11). In the northern Timiskaming country, Canada, increasing rate of ice retreat records a temperature rise about 12,500 B.P., while a change to re-advance introduced the cool Cochrane age some 11,300 B.P. (Antevs 1953: 197, 206, 208). Deep-sea sediments from the Atlantic and Caribbean suggest a marked temperature increase the beginning of which has been radiocarbon-dated at roughly 13,000 B.P. (Ericson and others 1956: 387; Emiliani 1957: 387). Thus various evidences indicate a distinct temperature rise beginning 13,000 to 12,500 years ago.

In the Patschke peat bog, 40 miles east of Austin, Texas, boreal spruce and fir pollens disappear, while oak pollen increases, at the 17.5-foot level below the bog surface, signaling a distinct rise in temperature (Potzger and Tharp 1947). The first part of the relatively warm age, represented by the 17.5-to-15.5 foot levels, was also dry. In a pollen profile from the San Augustin Plains in west-central New Mexico subalpine spruce pollen shows a general though interrupted relative decrease from the depth of 40 feet to that of 14 feet, practical absence in 14 to 12 feet, a moderate maximum at 12 to 4 feet, and then absence to the ground surface (Clisby and Sears 1956). The spruce graph is an approximate thermograph, a minimum indicating high, a maximum, low temperature. In the upper 14 feet semidesert shrub and grass pollens, which are a rough measure of aridity, have a generally inverse frequency to the spruce pollen. The 19-foot level has been radiocarbon-dated at 19,700±1600 years (Magnolia Petroleum Co.). The warm and dry age recorded at the 14-to-12 foot level here may be the same as that indicated in the Patschke bog. The beginning of both may be correlated with the temperature rise in the glaciated regions and the Atlantic 13,000 or 12,500 years ago, and the warm and dry age may be dated roughly at 12,500–10,800 B.P.

The pollens in the San Augustin Plains graph seem to suggest that during the comparatively warm and dry period the region was cooler but possibly as dry as at present. However, at Double Adobe, 12 miles northwest of Douglas in southeastern Arizona, this drought did not induce arroyo cutting. This is clearly shown by the gradual, not abrupt, disconformity between two sets of beds at different ends of a long exposure, one set containing Sulphur Spring, the other Cazador artifacts of the Cochise culture. The drought was moderate. At Midland, in western Texas, the drought seems to be represented by the desiccation of the lake and erosion of its exposed floor which occurred between the deposition of the white lake sand, unit 1, and the accumulation of the wind or playa deposited gray sand, unit 2 (Wendorf, Krieger, and Albritton 1955: 67, 72, 113). In the Bonneville basin of Utah there might have been a contemporaneous mild drought between the Stansbury and Gilbert stages, as these have been dated by Eardley, Gvosdestsky, and Marsell (1957: 1190, 1196, 1198). The relatively warm and dry age may be named the Datil Interval, or the Datil Drought, after the village on the north edge of the San Augustin Plains. With the Datil Drought prevailing some 12,500–10,800 B.P., it may be presumed that the mammoth had become extinct in the Southwest by 11,500 B.P.

In southeastern Arizona not only the mammoth-hunting Llano man preceded the extinction of the mammoth, but also the food-gathering Cochise man of the Sulphur Spring stage of development. A campsite of the early Cochise man on a stream at Double Adobe was later covered by a perennial pond, as recorded by a deposit consisting of alternating laminae of silt and clay (Sayles and Antevs 1941: 46). From these pond sediments Byron Cummings and students in 1926 removed the upper jaw of a

mammoth, teeth and tusks in sockets. Photographs taken at the time by Haury show that the tusks extended deeply into the pond beds. Since the current in the pond transported only fine debris, and since furthermore the heavy jaw occurred near the edge of the pond with the tusks towards deeper water, the mammoth evidently fell on the spot. The mammoth jaw was in situ.

Before drawing conclusions about the ages of the Sulphur Spring stage camp at Double Adobe and of the mammoth hunts at the Lehner site we should consider the radiocarbon dates bearing on the hunts and archaeologists' opinion that the Sulphur Spring stage, because of its milling implements, is considerably younger than 12,500 years. The organic materials from the Lehner site give inconsistent radiocarbon dates. Charcoal from the hunters' fires have produced ages ranging from 7022 ± 450 to $12,000 \pm 450$ years. The four old dates average 11,340 years; but an age of 13,000 years is also archaeologically credible. Materials from the black swamp soil have given 6356 ± 450, 6877 ± 450, and 7133 ± 350 years. These latter dates must be several thousand years too young, for the swamp bed buried mammoth bones and charcoal before these disintegrated and scattered, that is within a few years of the hunts. Also, the swamp indicates a relatively moist climate, not the Altithermal Long Drought.

The radiocarbon age of 11,340 years for the hunts dates them to the Alleröd interval of 12,500 (or 12,000) to 10,800 B.P. Therefore, since the hunts were conducted during a subhumid climate, two interpretations are possible: (1) either the Alleröd was subhumid in the Southwest and was not associated with the semi-arid 14-to-12 foot level in the San Augustin Plains profile, or (2) the Alleröd interval was semi-arid causing the extinction of the mammoth in the region, so that the mammoth hunts antedated the Alleröd, making the radiocarbon age of 11,340 B.P. for the hunts too young. Supporting the second alternative, the Alleröd seems to be the only known logical interval to be represented by the San Augustin 14-to-12 foot horizon. At Double Adobe geology and archaeology suggest that the subhumid climate during the Sulphur Spring stage was followed by a semi-arid phase and this in turn by a subhumid climate during the Cazador stage, all before the Altithermal Long Drought and the Chiricahua stage. The disappearance of the mammoth from the southern High Plains before the rise of the Folsom culture probably before 10,000 B.P., its presence in southeastern Arizona during the early part of the Sulphur Spring stage, the unlikelihood that it survived in Arizona more than two thousand years after its extinction on the southern High Plains, all suggest that the Sulphur Spring stage is older than archaeologists hold.

Conclusions

It therefore seems to be the lesser dilemma to conclude, *a*, that the semi-arid 14-to-12 foot level in the San Augustin Plains profile, the Datil Drought, represented the Alleröd of 12,500 (or 12,000) to 10,800 B.P.; *b*, that the Datil Interval caused the extinction of the mammoth in the Southwest as well as on the southern High Plains; *c*, that the Sulphur Spring stage of the Cochise culture at Double Adobe, being overlain by a pond bed containing a mammoth skull in situ, is more than 12,500 years old; *d*, and that the mammoth hunts at the Lehner and Naco sites, in which spears with Clovis fluted points were used, took place some 13,000 or more years ago.

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FAUNAL REMAINS FROM THE LEHNER MAMMOTH SITE*

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ABSTRACT

The Lehner site fauna includes at least nine individuals of *Mammuthus columbi* and one each of *Equus, Bison,* and *Tapirus*. Mammoth material consists chiefly of jaws and teeth and shows a great range of individual variation. The tapir is represented by one of the largest fossil tapir jaws described from North America. The accumulation is considered to represent several kills over a period of several months. Climate at the time of the Lehner hunts was probably more humid than at present, but not tropical. The radiocarbon date of about 11,000 B.P. is considered reasonable. New genera reported from other early man faunas are *Neotoma* from the Ventana complex and *Bison* from the Naco site.

THE GENERA represented by the paleontological material at the Lehner site can be listed with confidence as *Mammuthus, Equus, Bison,* and *Tapirus*. The type of fossil remains and the state of preservation are such as to make it inadvisable to attempt specific assignments, except in the case of the mammoth, which is referred to *Mammuthus columbi,* for reasons given below, but without any firm conviction that the specific designation is significant.

MAMMOTH

Mammuthus columbi. Mammoth remains include nine lower jaws of various degrees of completeness, about 12 isolated upper and lower teeth, two small tusks, and poorly preserved skeletal elements. Two of the jaws were associated with upper teeth, including, in one case, a tusk, but in both instances only rotten fragments of the skulls remained (Fig. 5). All of the lower jaws were incomplete; one was so poorly preserved that only the pair of teeth was salvaged. Some of the mandibles were overturned or inclined at high angles. In spite of the fact that none of the jaws was as complete or well preserved as was the single jaw at Naco, it is interesting that the jaws at Lehner, as at Naco, represented the best preservation of the fossil bone material. Not only was most of the skeletal material too rotten to collect, but not nearly enough elements were present to account for the minimum of nine skeletons that should have been present. The preponderance of jaws as compared with the rest of the skeleton might be accounted for by assuming that smaller, more compact bones such as tarsal and carpal elements were small enough to be more readily carried away by stream action, scavengers, or man, and that the larger units such as the skull or long bones were less durable than the jaws. Considering, however, the perfect preservation of the Naco jaw and its position several feet away from the bulk of the fossil material (Haury, Lance, and Antevs 1953, Figs. 3, 4), it is tempting to speculate that the lower jaws might have received special attention from the human hunters, perhaps only because they were of little value and were dragged aside during the butchering.

Most of the mammoth jaws and teeth are of juvenile individuals. The largest is of a young adult that had not lost the second molar teeth. Any estimate of the probable age and size of a given individual requires an identification of the teeth with respect to position in the replacement series. The cheek teeth in mammoths, as in modern elephants, were six in number in each half of each jaw. Replacement was from behind, with each later tooth pushing its predecessor forward and out of the jaw. The first three are designated as deciduous premolars 2 to 4, and the last three as molars 1 to 3. Only one tooth, or parts of two teeth, were in actual use in each half of each jaw at a given time. The third molar, which is erupted at about age 60 years in the modern Indian elephant, remains in use from the time it comes into occlusion until the death of the animal (Lull 1931). In general each later tooth is larger and contains more plates than the one in front of it.

Among the criteria that have been used in recognizing various extinct species of mammoths, in the absence of complete skulls and skeletons, are the size of given teeth and the number of plates they contain. The spacing, or compression of the plates, expressed as the number of plates in 10 cm., is also used as a diagnostic character of major importance. Any certain application of these features in taxonomy re-

* Gratitude is expressed to Philip Hershkovitz, Chicago Natural History Museum, for the loan of comparative material. Preparation of the fossils for study was made possible by facilities provided with a grant from the Rockefeller Foundation to the Geochronology Laboratories of the University of Arizona.

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quires identification of the teeth as to their position in the series. This is difficult because the number and compression of the plates varies with the position of the tooth and with the species. The compression ratio varies with the part of the tooth on which it is measured. The extent to which the supposedly diagnostic characters vary among individuals of the same species is not well known, but is probably great. Deraniyagala (1955) says that variability of molars in modern Ceylon elephants is so great that if isolated teeth were found as fossils they might be distributed among several fossil genera.

It seems likely that all of the fossil mammoth material from the Lehner site belongs to the same species. If so, a considerable amount of individual variation is indicated for some of the features that have been used in assigning isolated teeth and jaws to various species. Details of the study of the Lehner mammoth teeth will be published elsewhere; only general observations will be given here. The Lehner specimens appear to be assignable to *Mammuthus columbi*, although they do not fall entirely within the range of characters given for that species by Osborn (1942). This problem has been discussed previously (Haury, Antevs, and Lance 1953: 21–2). Most of the molar teeth from P2 to M3, both upper and lower, are represented at the Lehner site, but the M3's are known only from unerupted portions in the backs of two of the jaws and are too poorly preserved for detailed study. The compression ratio of the plates ranges from 5½ to 9 in most of the specimens, except in a few of the smaller milk teeth showing as many as 5 to 5½ plates in 5 cm., which would give a ratio of 10 to 11 plates in 10 cm. One tiny tooth only 29 mm. long, with only one or two very thin plates, probably represents a second deciduous premolar, which is the first tooth in sequence, and which according to Lull, is erupted in modern elephants at age two weeks and shed at age two years. The specimen shows the marks of wear, so had reached occlusion.

Two small tusks were found with the Lehner material, one slightly curved and one nearly straight (Fig. 5). The shorter, straight tusk has a worn facet on one side of the tip, suggesting use in digging. The small size of these tusks and the general absence of tusks might be taken to suggest a preponderance of females in the collection. The two largest jaws from the Lehner site are not as big as the Naco jaw, but a comparison of individual teeth suggests that the animals from the two localities would have been closely comparable at the same ages. For example, an unerupted tooth identified as the left lower third molar in specimen Number 133 from Lehner contains 15 plates, with some missing posteriorly, is 196 mm. long, and 79.5 mm. wide, with a compression ratio of 6½ to 8½. The lower right third molar of the Naco specimen contains 17 or 18 plates, is an estimated 245 mm. long, 86 mm. wide, and has a compression ratio of 6½ to 8. If the Lehner specimen contained as many as three more plates, the length would be about 240 mm. The differences shown by these and other measurements are comparable to the range of individual variation within the Lehner collection.

Variation shown in various details by the Lehner site material strengthens the view that the mammoth remains from Double Adobe site (Sayles and Antevs 1941) fall within the range of the species represented both at Lehner and Naco. The Double Adobe specimen was identified by Stock as *Archidiskodon* sp. (Sayles and Antevs 1941: 64), apparently because the wide spacing of the plates on the occlusal surfaces of the teeth suggested a greater resemblance to *Mammuthus imperator* than to *M. columbi*. This spacing is largely a result of the angle at which the plates are worn, and the general similarity of the Double Adobe specimen to that from Naco (Haury, Antevs, and Lance 1953: 22) makes it appear that an assignment to *M. columbi* would be logical for both specimens.

Bison

Bison sp. Three lower teeth in a jaw fragment, a fragment of upper tooth, a phalanx, and a few vertebral fragments represent a bison in the collection. The lower teeth are the three molars of the right side. The second molar, which is nearly intact, is 34.2 mm. long, and the estimated length for the three molars together is 110 mm. The enamel patterns of the teeth do not show any distinctive characters. The phalanx, which is a second one, is 48.6 mm. in greatest length, 35 mm. in antero-posterior diameter at the proximal end and 29.3 mm. at the distal end. The phalanx has a small black patch on one side, suggesting that it has been charred by fire. The material available does not warrant assignment to a species.

TAPIR

Tapirus sp. Identifiable tapir remains include a single left jaw with P_2–M_3, an isolated right P_2, and a fragment of an upper molar. The five cheek teeth in the jaw are heavily worn, and all but P_2 and M_3 are broken. The jaw itself is badly crushed and slightly charred, but is preserved well enough to show its great size, which is also shown by the measurements of the teeth. Direct comparisons with other fossil specimens is difficult, but the Lehner tapir seems to be larger than any fossil tapir described from North America with the single exception of *T. merriami* Frick from the early Pleistocene Bautista beds of California (Frick 1921). Certain specimens of the large Pleistocene tapir, *T. copei* exceed the Lehner site specimen in a few individual tooth dimensions, but in almost all measurements the teeth of the Lehner tapir exceed the maximum as well as the average values listed for *T. copei* by Simpson (1945). The depth of the jaw below the alveolar border of M_1 is 80 mm. The jaw is crushed, but the measurement gives an approximation of the size. Other North American Pleistocene and all living tapirs are considerably smaller than the Lehner form, except for *T. merriami*.

Measurements of lower teeth of the Lehner tapir are given in Table 3 for comparison. No specific determination is attempted at present. More detailed study of size and proportions of teeth may show the specimen to be a large individual of *T. copei*.

TABLE 3. MEASUREMENTS OF LOWER TEETH OF *Tapirus* sp.

Tooth	*Length*	*Anterior Width*	*Posterior Width*
RP_2	26.7+	----	17.9
LP_2	26.7e	16.8e	21.4
LP_4	29.7	20.4	20.7e
LM_1	25.4	20.8	20.6
LM_2	30.6e	22.6e	22.3e
LM_3	33.7	24.2	21.1

Measurements in mm.; e = tooth broken, measurement approximated at cingulum.

HORSE

Equus sp. A single distal fragment of a metapodial of a horse is considered as probably assignable to *Equus*. The genus is known from a number of early man associations, and its presence at Lehner is not unusual. The only surprising thing is the scarcity of horse remains at the locality.

ADDITIONS TO NACO AND VENTANA FAUNAS

Specimens found at Naco and Ventana Cave since the last publication on those localities are reported here to keep the faunal records current. New genera from the early man horizons at both places are *Bison* sp. at Naco and *Neotoma* at Ventana Cave. Scraps of bison teeth were collected by Haury in 1957 at Naco from the bone layer at a point across the arroyo and a few meters upstream from the original mammoth locality (Haury, Antevs, and Lance 1953). There can be little doubt of the stratigraphic continuity of the bed containing the bison teeth with that containing *Mammuthus* and Clovis points. A *Neotoma* jaw was collected in 1952 by Haury at Ventana Cave from the pillar left for stratigraphic identification at the time of the original dig (Haury 1950). He reports that the specimen came from the volcanic debris layer, which contained artifacts associated with a largely extinct fauna. *Neotoma* is reported from most of the upper layers containing modern faunas. *Neotoma* is also reported from Papago Springs Cave (Skinner 1942).

ACCUMULATION OF DEPOSIT

Spear points, fire pits, and butchering tools associated with the Lehner site fauna suggest that conditions under which the fossils accumulated were influenced by hunting activities of man as well as by normal sedimentational processes. Except, however, for the presence of artifacts and charred bone, the fossil assemblage does not seem to show features greatly different from those of any typical fossil occurrence in a stream channel. Certain things, such as the preservation of the mandibles, the absence of carpal and tarsal bones, and the preponderance of mammoths, particularly of young individuals, might be the result of selectivity by human hunters. It may be, of course, that the selectivity was partly one of location. Perhaps mammoths tended to frequent this particular stretch of river bank as a watering place and other animals avoided it. If this were true it would suggest that the hunters visited the spot deliberately in search of mammoths, probably on several occasions. Rarely a horse, bison, or tapir might have been surprised at or near the watering place. The charring of the tapir jaw and of the bison phalanx suggest that two animals represented were killed at or near the spot by man and that their bones were not simply washed in from upstream.

It is unlikely that the proportion of animals in the assemblage reflects their relative abundance in the area at the time. Bison and horse would be expected to occur in herds. Tapirs, on the other hand, may never have been present in large numbers. They may have lived commonly in the adjacent mountains, or they may have lived along the stream course, but simply not have been more abundantly represented at the

fossil site because of one of the selectivity factors mentioned above. In any event, the implication is that the early men represented at Lehner and at Naco were definitely mammoth hunters, although smaller animals also certainly were included as prey.

The amount of time represented by the accumulation at the Lehner site is an interesting subject for speculation. One interpretation would be that a single mass kill is represented. The fossil remains were weathered, broken, and scattered, and were distributed through successive layers of sand and gravel. This disturbance of the material could have taken place in a relatively short time as the result of butchering activities of the hunters, work of scavengers, trampling by live mammoths, and weathering and stream action. The presence of one jaw with the upper teeth in contact in weathered remains of the maxillary above and a tusk projecting about 75 cm. below the level of the lower jaw (Fig. 5) suggests a considerable amount of scouring and filling in the channel in a relatively short time, perhaps in one flood.

The fragmentary remains of three animals other than mammoth, however, might be taken to indicate that the assemblage was not the result of a single hunting foray, unless it be assumed that all of the heterogeneous group was trapped in the watering place so that escape was impossible for any of them. It seems more likely that several successive kills are represented. The varying states of preservation of the fossil material suggest varying periods of exposure to weathering. The amount of apparently rapid scour and fill indicated for the stream channel, however, indicates that the accumulation probably did not take place over any great period of time. I would judge that the time of accumulation is to be measured in weeks or months, but probably not in years.

Age and Climatic Implications of Fauna

All of the extinct animals found at the Lehner site are known from other localities in association with early man artifacts, although the exact combination found there is unique. The absence of certain animals known from other localities in the Southwest does not necessarily mean anything as to their presence or absence in the area at the time. The presence of mammoth, horse, tapir, and bison at other localities that are judged on geological and archaeological evidence to be younger than Lehner means simply that the Lehner accumulation took place at some indefinite period of time before the extinction of these animals in this area. The antiquity of the Lehner site occurrence then, is based not on the fossils but on the artifacts and on the geologic-climatic relationships.

An extremely interesting and valuable contribution to interpretations of the relationships of Pleistocene faunas and early man is that of Jelinek (1957). Jelinek, using admittedly limited information, attempts to show possible times of migrations and extinctions of Pleistocene animals known from early man sites. His results suggest that some animals disappeared earlier in certain areas than in others, and that in a few cases the time of first appearance of an animal in a given area can be useful as a paleontological guide. The Lehner site would fit into Jelinek's (1957, Fig. 2) chart in about the same position as Naco, which is shown as being earlier than the extinction of mammoth, horse, and bison in the western part of the southeastern Basin and Range province. Tapir is not listed by Jelinek, as it is known only from one other locality in this general area, at Ventana Cave, at least as far as human associations are concerned. Considering that most of the early man faunas from Arizona represent chance preservation of a limited part of the animal life that existed at the time, any dating based upon fossil faunas must be considered only tentative, as Jelinek points out. Unfortunately, the Lehner fauna does not contain anything to add refinement to the tentative scheme. On a purely subjective interpretation of the geology, I would consider Papago Springs Cave to be older than both Naco and Lehner, rather than younger, as shown by Jelinek. Jakway (1958) suggests that the Papago Springs Cave fauna is of about the same age as that from San Josecito Cave in Nuevo León, and that both are older than Rancho La Brea, which is generally considered to be pre-early man.

Double Adobe, which is not discussed by Jelinek, contained mammoth, horse, and bison in beds above type artifacts of the Sulphur Spring stage of the Cochise culture. Haury, Antevs, and Lance (1953: 13) consider the Sulphur Spring stage to be younger than the Ventana complex, and Ventana, in turn to be younger than Naco. These relationships suggest that the time of extinction of the mammoth in the Arizona region was later than shown on Jelinek's chart. Absence of mammoth at Ven-

tana may well be a matter of sampling inadequacy rather than actual absence in the area.

The various Arizona early man cultures have not yet been found in stratigraphic superposition, and relative and absolute age estimates based on climatic-geologic interpretations and radiocarbon dates are not entirely consistent. The radiocarbon date of about 11,000 years for Lehner seems logical, however, in view of all available evidence. Naco must certainly be of almost the same age as Lehner, with Ventana somewhat younger. Radiocarbon dating of Double Adobe at between 7500 and 8000 years seems also consistent, and suggests that some major elements of the Pleistocene fauna survived to a period near the beginning of the Altithermal. Faunal extinction at this time in Arizona may have been related both to the climatic change and to activity of man himself, and the faunal change may in turn have influenced cultural modifications from a hunting to food-gathering economy (Haury, Antevs, and Lance 1953: 13). The extinction of mammoths and other animals near the beginning of the Altithermal serves as a convenient place for the Pleistocene-Recent boundary on the geological time scale.

The Lehner site fauna suggests some climatic change between the time of its accumulation and the present. Greater moisture and more vegetation seem required for the fauna. I would not, however, postulate anything approaching tropical conditions, as the presence of tapir might at first seem to imply. Colbert (1950) has discussed the rather surprising nature of the presence of tapir in the arid Southwest at Ventana Cave. Both he and Simpson (1945) point out that except for Ventana, and an occurrence at El Paso, all fossil tapir localities in the Pleistocene of North America fall within or near the zones now receiving more than 20 inches of rainfall annually, zones which might have been even much moister during parts of the Pleistocene. As most of the other animals known from the Arizona early man localities do not seem to require as much moisture as the living tapir, it would appear easier to assume that the tapirs at Lehner and Ventana represent an extension of range into an area somewhat moister than it is at present, but not tropical, by any means. The tapirs possibly lived in valleys along perennial streams which must have existed at that time, or in wooded mountain areas. Also, two recent discoveries of tapir in the arid Southwest are now known, both localities, as yet undescribed, being in west Texas (W. S. Strain, personal communication). This gives a total of five tapir localities from the late Cenozoic of this general area, suggesting, perhaps, a species or race adapted to living under dryer conditions than other tapirs.

UNIVERSITY OF ARIZONA
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THE LEHNER MAMMOTH SITE

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THE EASTERN DISPERSAL OF ADENA*

WILLIAM A. RITCHIE AND DON W. DRAGOO

ABSTRACT

In the upper Ohio Valley, Adena mounds and their burials are less complex than, but essentially similar to, those of the major Adena centers of Ohio and Kentucky. Chronologically, they belong in the middle and late Adena periods. Two Adena sites much farther east have been found on Chesapeake Bay; they are closer in trait inventories and in radiocarbon dates to upper Ohio Valley sites than to Adena sites farther west. A reappraisal of evidence from the Northeast, particularly the Middlesex focus of New York, strongly suggests the movement of Adena people as far as the St. Lawrence River, although the proportion of Adena traits diminishes as distance from the Ohio Valley increases. Still another Adena dispersal, probably contemporaneous with this one, has previously been postulated to account for the Copena complex of Tennessee and Alabama. The cause of these rapid and far-reaching movements was probably the arrival or growth of Hopewell people in Illinois and Indiana and soon after in Ohio.

THE BASIC IDEAS in this paper were formulated by the authors at an informal conference on Adena and related topics at the University of Kentucky in October, 1957, and in further discussion at the annual meeting of the Eastern States Archeological Federation in Baltimore in the following month. It seemed that the relationships of Adena manifestations in the upper Ohio Valley, the Northeast, and Maryland warranted additional detailed study and interpretation. Accordingly, Ritchie concentrated on Adena complexes in the Northeast while Dragoo directed his attention to the upper Ohio Valley Adena. We both brought our lines of focus to bear on the data from the little known Adena sites on Chesapeake Bay. During April, 1958, we met at the New York State Museum to integrate our respective data and independently achieved interpretations. The present paper represents the consensus of this meeting.

UPPER OHIO VALLEY

Two major centers of Adena occupation, one on the Scioto River in southern Ohio and the second on the Kanawha River near Charleston, West Virginia, have been recognized by Webb (Webb and Snow 1945: 132). Lesser centers are located in Indiana, Kentucky, Ohio, and West Virginia. The most eastern of these smaller centers, and the one most pertinent to our present problem, is situated in the area around the Grave Creek Mound at Moundsville, West Virginia, extending up the Ohio River to the junction of the Allegheny and Monongahela rivers in western Pennsylvania. Within the immediate area of Moundsville, 47 mounds and evidences of a wall of earth are known (DeHaas, n.d.; Hennen 1909: 12). Most of the available information on Adena in this area comes from the excavations of Grave Creek Mound (Norona 1957), Beech Bottom Mound (Bache and Satterthwaite 1930), Natrium Mound (Solecki 1953), and Half-Moon Mound (Fetzer and Mayer-Oakes 1951).

Going up the Ohio River from Moundsville, the number and concentration of earth mounds supposedly of Adena origin decrease as one approaches Pittsburgh. In addition to mounds, there are several village sites scattered along the Ohio River up to Pittsburgh on which characteristic Adena traits have been found on the surface or eroding out of the banks of the river. Important among these items are fragments of blocked-end tubular pipes, reel-shaped gorgets, stemmed points of Adena type, and Fayette Thick pottery.

At the Watson Site in Hancock County, West Virginia, Fayette Thick pottery was found stratigraphically below a Middle Woodland burial mound constructed of stone (Dragoo 1956). On the surface of this site were found stemmed points and fragments of gorgets drilled from one side only in the typical Adena fashion. Just below the junction of the Allegheny and Monongahela rivers at Pittsburgh, the largest Adena earth mound east of Moundsville was built on the high bluff at McKees Rocks (Swauger 1940;

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We have both had the advantage of a firsthand examination of the Adena materials in the Museum of Anthropology at the University of Kentucky and in the Ohio State Museum, through the courtesy of William S. Webb and Charles E. Snow of the former institution, and Raymond S. Baby at the latter. We also wish to record our appreciation to T. Latimer Ford of the Archeological Society of Maryland for the opportunity of examining the large collection from the West River and Sandy Hill sites at the Maryland Academy of Sciences, and for the loan of photographs and other data.

Carpenter 1951; Mayer-Oakes 1955; McMichael 1956). Several small earth mounds of apparent Adena origin were built within a radius of ten miles. All of these mounds have fallen victim to the expanding city of Pittsburgh.

Assuming that the Adena people spread eastward and up the Ohio Valley from the centers in Ohio and West Virginia, on arrival in the Pittsburgh area they would have been faced with the choice of turning southward up the Monongahela Valley or northward up the Allegheny and Beaver valleys. The Monongahela Valley seems to have been more appealing, but the Allegheny and Beaver valleys were not ignored. No earth mounds are known for the Youghiogheny drainage, the major eastern tributary of the Monongahela, but small stone mounds, some of which may be of Adena origin, have been located as far east as Garrett County, Maryland. Stemmed points, gorget fragments, and potsherds similar to Fayette Thick have been found on sites near these mounds. In Garrett County, the drainage basins of the Ohio and Potomac rivers are separated only by a narrow mountainous ridge which can easily be crossed. The presence of Adena-like points and gorget fragments in surface collections from the Potomac Valley indicates that this was the probable route used by some Adena people in their eastward movement.

The Allegheny Valley is of considerable interest in tracing the eastward movement of Adena, because it forms the natural water highway from the Ohio Valley into New York and the Northeast where the Adena-like Middlesex complex has been found. However, no earth mounds of definite Adena origin are known for the Allegheny Valley. The Oakmont Mound and the Darlington Mound, both located in the lower Allegheny near Pittsburgh, may be of Adena origin, but the information is such that they could also be classified as Hopewellian. Several stone mounds have been studied in the middle and upper Allegheny Valley, but all of these structures appear to have Hopewellian rather than Adena traits (Schmitt 1952: 61). Items assignable to Adena do occur on several village sites scattered throughout the entire Allegheny Valley. Among the most diagnostic of these items are blocked-end tubular pipes of fireclay, cigar-shaped open-end stone tubes, and rectangular gorgets (Mayer-Oakes 1955: 63).

In summary, the distribution of Adena components in the upper Ohio Valley is one of decreasing magnitude as one moves eastward from the Moundsville area. The burial mounds decrease both in number and size, with the McKees Rocks Mound near Pittsburgh representing the most eastern Adena structure of sizable proportions. Only in the Monongahela Valley to the south do there appear to have been Adena earth mounds in any number, but all of these mounds were relatively small compared to those located along the Ohio River. The Monongahela Valley earth mounds are also within a radius of 50 miles overland from the concentration of burial mounds at Moundsville. Stone mounds of possible Adena origin along the Cheat and Youghiogheny tributaries of the Monongahela have been found as far as eastern West Virginia and western Maryland.

No mounds in the Allegheny Valley, except in the immediate vicinity of Pittsburgh, have been identified as of Adena construction. Adena traits are found, however, on a number of village sites in that area as far north as New York. Mound and burial traits of the upper Ohio Valley Adena mounds are similar to those of the Ohio and Kentucky mounds. With the exception of the Grave Creek Mound, the upper Ohio Valley mounds tend to be less complex and elaborate than in the central Ohio Valley.

The most outstanding artifact traits of the upper Ohio Valley Adena mounds are: blocked-end tubular pipes, reel-shaped gorgets, hematite cones and hemispheres, leaf-shaped flint blades, rolled copper beads, and copper gorgets. All of these items were found in the Natrium Mound, and all except copper gorgets were present in the Beech Bottom Mound. Webb and Baby (1957) list all of these traits, except copper gorgets, as typical of middle Adena. The presence of copper gorgets at Natrium, Peters Creek, and Crall mounds would indicate that these mounds were constructed towards the end of the middle Adena period, since the extensive use of copper was considered as rather late at Adena sites in the central Ohio Valley.

Because radiocarbon dates are lacking for any of the upper Ohio Valley mounds, we must conclude that on a typological basis the majority of the Adena mounds in this area were built during the middle and late periods of Adena, as defined by Webb and Baby (1957: 112, 124). Radiocarbon dates of about 290 B.C. (CP–45, 2240±100 B.P., 1955; Diethorn 1956: 132), and A.D. 50 (CP–47, 1900±100 B.P., 1955; Diethorn 1956: 132) for hearths associated with Fayette Thick pottery in the Lock 3 village site, tend to support this conclusion.

EASTERN MARYLAND

From two sites located on opposite shores of Chesapeake Bay in Maryland have come a vast quantity of Adena objects in association with burials and pit cremations covered with red ocher. Although various articles on these materials have been written, a recent report, accompanied by radiocarbon dates, by T. Latimer Ford of the Maryland Archeological Society, gives the most complete résumé of the finds which number over 700 objects (Weslager 1942: 145–9; Mason 1953; Ford 1958). Important diagnostic Adena traits at these sites include blocked-end tubular pipes, large blades and points of Flint Ridge, Ohio and Harrison County, Indiana flint, cones and hemispheres, gorgets and pendants of various forms, and copper beads. Other less diagnostic Adena traits found at these sites include the boatstone and birdstone. There was also a Copena type of effigy pipe in one of the graves.

There can be little doubt that the Maryland Adena sites are more closely related to the upper Ohio Valley Adena sites, particularly the Beech Bottom and Natrium mounds, than to those of any other area. More blocked-end tubular pipes have been found in the upper Ohio Valley Adena mounds and in the two Maryland sites than in all the Adena mounds of Ohio and Kentucky combined; 84 blocked-end tubular pipes, plus fragments of many more, have been found in these eastern sites, in comparison to only four recorded for Ohio and Kentucky. Only in Middlesex are blocked-end tubular pipes in comparable abundance to the upper Ohio Valley and Maryland sites.

The three radiocarbon dates of 75 B.C. (M–418, 2030±250 B.P., 1955; Ford 1958: 10), A.D. 255 (M–419c, 1700±250 B.P., 1955; Crane 1956: 669), and A.D. 325 (M–418, 1630±400 B.P., 1955; Ford 1958: 10) years obtained by Ford for the West River site in Maryland are of extreme interest because they overlap the two dates of 290 B.C.±100 and A.D. 50±100 for a site of probable Adena affinity in the upper Ohio Valley. The earlier range of dates for the upper Ohio Valley Adena lends support to our belief that the Maryland Adena sites were derived from and culturally related to the upper Ohio Valley Adena complex. This relationship, we maintain, rested upon the actual transfer of groups of Adena people and their culture to the east, northeast, and south.

The Maryland radiocarbon dates, as well as the upper Ohio Valley dates, indicate that the movement of some Adena groups eastward out of the Ohio Valley took place in the late middle Adena period rather than during the late Adena period. The dates of A.D. 529 (C–847, 1425± 250 B.P., 1954; Libby 1954b: 737) for the Florence Mound in Ohio, and of A.D. 782 (C–126, 1168± 150 B.P., 1950; Arnold and Libby 1950: 7) for the Drake Mound in Kentucky (Webb and Baby 1957: 124) indicate, however, that Adena was still present in the central Ohio Valley more than 500 years later than in the upper Ohio Valley and Maryland.

Interesting parallels to the eastward movement of Adena out of the Ohio Valley are also found in a movement to the southeast where Adena has been recognized as the basis of Copena in Alabama and Tennessee (Webb and Baby 1957: 79). Webb first believed Copena to have been a southern manifestation of Hopewell (Webb 1939: 189–201), but a later re-evaluation of Copena's relationships to Hopewell and Adena was recently summarized by Webb and Baby (1957: 80).

It is obvious from these facts that Adena has made large cultural contributions to Copena in the Tennessee Valley, which includes all of northern Alabama and at least two sites in Tennessee, one in Hardin County and one in Marshall County. Because of the increased information on Adena since 1945, it seems that the cultural contribution of Adena may be evaluated correctly as greater than that of Ohio Hopewell to Copena. This may be possible because the contribution of Adena to Copena may have been more direct.

THE MIDDLESEX COMPLEX

The Adena groups which fled into the Northeast, either through the Allegheny Valley or the Delaware, or both, seem to have been small shatter groups, possessed for the most part of more limited quantities of cherished material than seen at Sandy Hill, Maryland, which, in the main, ultimately became grave goods. Meeting various degrees of resistance, these small bodies of detached Adena people seem to have pre-empted certain limited sections in the Connecticut, Champlain, Mohawk and other large waterways, and to have reached even the St. Lawrence Valley.

Probable influences from the Adena culture in the archaeology of the Northeast were first mentioned by Ritchie in a paper published in 1932 (Ritchie 1932: 412). Subsequently (Ritchie 1936: 4; 1937: 186–7) he designated and described the Middlesex focus and specified the traits having affinities with the Adena of Ohio.

It was recognized that the Middlesex complex as a whole could not be equated with Adena, but that a number of its salient elements characterized Adena as defined by Greenman (Greenman 1932). It was concluded that, unlike the New York Hopewellian manifestation, Adena was not represented in a relatively pure state in the Northeast, but rather certain of its distinctive elements had been interfused with one or more old, regional manifestations, the resultant complex being termed the Middlesex focus, from the locality of a type site in central New York (Ritchie 1937: 192–3). The chief coincidences of Middlesex and Adena were stated to be the blocked-end tubular pipe, the leaf-shaped knife, discoidal shell bead, copper bead, copper awl with rectangular cross section, and boatstone (Ritchie 1938: 100–3; 1944: 112–5, 186–7; 1951a: 131–3).

Now, in the light of more recent site discoveries and the appearance of Webb and Snow's *Adena People* and Webb and Baby's *Adena People No. 2*, a reappraisal of Adena-Middlesex relationships has been made possible. The new evidence would seem to indicate the actual migration of groups of Adena people into the east and northeast, their considerable dispersal along certain major waterways, and their ultimate differential cultural assimilation into various local populations.

The detailed reanalysis of available material attributed to the Middlesex complex comes from 19 burial components, varying greatly in size from one or two to approximately 25 graves, distributed from New Jersey to the Canadian border, and from western New York to southern Maine. The close proximity to rivers or lakes of burial sites and find-spots of blocked-end tubes is evident, and two major water routes seem likely for the postulated movement of Adena groups into the east and northeast. To the west, dissemination seems to have taken place along the Ohio River and the tributary Allegheny River into western and central New York. On the east, connections, while at first more tenuous, indicate a spread from the Monongahela Valley to the Potomac Valley, to Chesapeake Bay, thence northeastward into Delaware, where a site of this kind is reported near Felton (Weslager 1942: 145), thence along the Delaware River through New Jersey into central New York. From the northern New Jersey region, where the Rosencrans site, although classed as Middlesex (Carpenter 1950: 298–303), shares 89% of its traits with Adena, diffusion radials seem to extend northward through the Hudson–Champlain–St. Lawrence and Connecticut valleys. Here, or within a few miles of the Hudson on the tributary Mohawk River, occur most of the Middlesex sites of the eastern half of New York and of New England. It seems not without significance that, in general, the percentage of Adena traits in these components diminishes from nearly 100% at Sandy Hill, Maryland, and 89% at Rosencrans, New Jersey, to between 64% and 82% in the western Vermont sites, and to 75% at Long Sault Island in the St. Lawrence. Lest it be suspected that the postulated direction of movement from south to north is merely conjectural, and that these Middlesex stations may antedate Adena in the Ohio River basin, we adduce in proof of our assumption, the considerable proportion of Adena type artifacts in Middlesex which are manufactured from stone materials native to the Ohio River basin, but exotic in the north. These materials include Ohio pipestone, Flint Ridge chalcedony, and Harrison County, Indiana flint.

The picture of Adena-Middlesex relationship would undoubtedly be clearer but for the unfortunate fact that almost without exception, Middlesex data have been gathered haphazardly, for the most part following accidental disclosure of the site by commercial gravel or sand digging. Such site descriptions as it is now possible to obtain have, in the main, been published elsewhere (Perkins 1874: 76–100; Frey 1879: 639–44; Terry 1881; Moorehead 1922: 46–9; Willoughby 1935: 83–7; Ritchie 1944: 187–200; Carpenter 1950: 298–305). It should be added that recognized habitation sites having a possible Middlesex component are indeed few in number and are confined to northwestern Pennsylvania, where they have variously been classed as Middlesex and Adena (Mayer-Oakes 1955: 58–63). These resemble Adena village sites in Ohio and Kentucky in lacking refuse deposits and in otherwise suggesting a settlement pattern characterized by widely scattered houses (Webb and Snow 1945: 314). Finally, we may add, that previous statements regarding the total lack of burial mounds in the Middlesex complex seem in need of revision by recently acquired data for the Long Sault Island site in St. Lawrence County, New York.

In the reanalysis of the available Middlesex data, 92 traits were enumerated of which 74 constituted artifact traits and 18 pertained par-

ticularly to burial practices. Of this total, 33 or 35.8% (24 artifact and 9 burial traits) were found to be highly diagnostic for Adena, as defined by Greenman (1932), Webb and Snow (1945), and Webb and Baby (1957). In addition, there were 18 traits or 19.6% of the total (13 artifact and 5 burial traits) which occur in Adena as less diagnostic markers of this culture. The remaining 41 traits, or 44.6% of the total (37 artifact and 4 burial traits), are at present unreported for Adena. The Middlesex complex, as imperfectly known, is thus shown to comprise 51 (or 55.4%) of traits more or less diagnostic for Adena, and 41 (or 44.6%) of traits which we may currently regard as non-Adena, differentially distributed within the 19 Middlesex sites. The ratio of diagnostic Adena traits within a site varies considerably, and in the eastern half of the site range, at least, the proportion of Adena traits varies inversely with the distance of the site from the Adena heartland.

In western and central New York, the percentage of Adena traits on Middlesex sites ranges from 100% at the Walch component where, however, only four traits are reported, to a minimum of 60% at the Vine Valley site which has 25 traits. It would seem, therefore, that the assimilation of Adena in this area had proceeded more rapidly and thoroughly than in the eastern half of the Middlesex range. This may perhaps best be explained by the archaeologically established fact of a heavier concentration of Point Peninsula occupation in the western area (Ritchie 1944: 113). It seems also possible that Adena entry occurred entirely through the postulated eastern or Delaware Valley route, rather than via the Allegheny, where more resistance from resident groups may have been encountered, and that diffusion subsequently occurred from eastern New York, via the Mohawk Valley, into the Finger Lakes region. Ritchie recognized early that Point Peninsula constituted primarily a western manifestation in the New York area, Middlesex an eastern one, and a measure of contemporaneity was suggested by the evidence from shared traits. Accordingly, he postulated a Vine Valley aspect for these two cultures (Ritchie 1937: 192–3; 1944: 113, 115, 186–7). This assumption is sustained by the new study which shows that a large percentage of Middlesex traits are also present in Point Peninsula, particularly in the middle stage. Some elements of this stage, such as *Marginella* shell beads, cylindrical shell beads, large antler flaking tools, and antler combs may have been introduced by Adena contact.

Unfortunately, radiocarbon dates are lacking both for the Middlesex and middle Point Peninsula cultures. For the early Point Peninsula we have three such determinations ranging from about 2448 B.C. (C–794, 4400±260 B.P., 1952; Libby 1954a: 137) for the Red Lake site in northern New York (Ritchie 1955: 66–7), through 998 B.C. (C–192, 2948±170 B.P., 1950; Arnold and Libby 1950: 7) for the Oberlander No. 2 site in central New York (Ritchie 1951b: 31–2), to 563 B.C.±250 for the Morrow site in the western part of the same state (date published by permission of Rochester Museum of Arts and Sciences). Ritchie believes that these sites represent regional manifestations of a widely spread pre-Adena stage of Early Woodland culture which may have contributed certain elements to early Adena, such as the tubular cigar-shaped clay pipe; leaf-shaped mortuary blade usually found in caches; rectanguloid gorget; birdstone; copper bead, celt, and awl; discoidal shell bead; various cremation traits; use of red ocher in graves; and intentional breakage of grave goods. The last three of these elements are part of a mortuary ceremonialism which seems to have constituted a prior development of the subsequently elaborated burial cults of Adena and Hopewell (Ritchie 1955: 71–6).

The Maryland Adena dates previously given are the only eastern Adena dates available and they suggest the arrival of Adena in Maryland in late middle Adena times. If our assumptions are correct, this was the approximate period of the eastern dispersal of Adena groups which, pressing on to the northeast of the Chesapeake Bay region, subsequently became responsible for the genesis of the Middlesex complex.

The Rosencrans site on the Delaware River in northern New Jersey has, as already remarked, 89% of its recorded traits equatable with Adena. Moreover, this list includes such characteristic middle Adena artifact elements as blocked-end tubular pipes; copper and stone boatstones; large, well-made, stemmed projectile points; and the cone or hemisphere. Similarly, throughout most of the Middlesex series, the prevailing Adena traits point to the later aspects of that culture, as for instance, the modified tubular pipes of the Walch site, the keeled gorget from Long Sault Island, and the persistent blocked-end tubular pipes of mottled gray pipestone. One such tube from the Swanton cemetery, it

may be added parenthetically, bears an engraved bird representation, suggesting a relationship to the raptorial bird concept illustrated by the Adena tablets (Willoughby 1935, Fig. 50 *a*; Webb and Baby 1957: 83–101).

We have noted the generally progressive dilution of Adena traits in the Middlesex site complexes with increasing distance from the Adena center. Nevertheless, one of the largest and most peripheral of these stations, the burial mounds on Long Sault Island in the St. Lawrence River, produced 75% diagnostic Adena traits, composed primarily of stone materials foreign to the Northeast, but traceable to Flint Ridge and probably Portsmouth, Ohio, Harrison County, Indiana, and elsewhere in Adena territory. The remaining traits at this component are equally characteristic of either Hopewell or Point Peninsula. The Rosencrans and Long Sault sites in particular seem to us to argue strongly for the entry into the Northeast of shatter groups of actual Adena people, bearing with them goods made in their Ohio Valley homeland. The Chesapeake Bay sites, particularly the immense Sandy Hill cemetery, already discussed, present even more unassailable evidence of a major exodus eastward from the Ohio River basin.

Conclusion

We believe that it is more than mere coincidence that the eastern, northeastern, and southern extensions of Adena occurred at approximately the same time during the middle Adena period. The wide scattering of Adena traits from the homeland in the Ohio Valley cannot, we think, be explained as the wandering of traders in search of new markets or raw materials. The finding of typical Adena objects made from Ohio Valley stone materials, and in the context of the Adena ceremonial burial pattern, at these far-flung outposts can best be explained only by the actual presence of Adena people. Why would groups of Adena people want or find it necessary to leave the Ohio Valley which had been their home for at least 600 years? The apparent answer to this question is that internal strife or outside force, or a combination of both these factors, drove them from the Ohio Valley. When we seek the cause of disruption in Adena, the movement of Hopewell people into the area appears to provide the logical clue.

Although Adena would seem to be definitely older than Hopewell, recent radiocarbon dates indicate that Hopewell was thriving in Illinois and western Indiana before the end of the early Adena period. The Hopewell Mound at Havana, Ill., has been dated at 386 B.C.±250 (C–152, 2336±250 B.P., 1950; Arnold and Libby 1950: 8) (Webb and Baby 1957: 124). At the annual meeting of the American Anthropological Association in Chicago, December 1957, James B. Griffin reported that yet unpublished dates will push the Hopewell occupation of Illinois even farther back in time. [This was written before the publication of Griffin 1958. — Editor.]

The radiocarbon dates for Hopewell in Ohio and the upper Ohio Valley suggest that Hopewell began its eastward encroachment on Adena during the middle Adena period. The dates for the Hopewell Mound 25 in Ohio range from 335 B.C.±210 (C–137, 2285±210 B.P., 1950; Arnold and Libby 1950: 8) to A.D. 1±200 (C–136, 1951±200 B.P., 1950; Arnold and Libby 1950: 8). A date of 185 B.C.±200 years has recently been reported for the Georgetown site in western Pennsylvania (Mayer-Oakes 1958: 13). This date was from a charcoal sample removed from a hearth which contained two Watson Cordmarked and two Fayette Thick sherds. The hearth was located at the lowest level in which the Hopewellian Watson pottery occurred and at the top of the level containing Fayette Thick sherds. Fayette Thick sherds continued to a depth of 18 inches below the dated charcoal sample.

These early dates for the arrival of Hopewell in Ohio and western Pennsylvania are remarkably close to the dates previously stated for the far-flung Adena sites in Maryland. We believe the dispersal of some Adena groups to the Northeast, East Coast, and Southeast to be the direct result of the Hopewell intrusion in the central and upper Ohio Valley.

We suspect that the arrival of Hopewell groups from the Illinois area into the Adena heartland in the central Ohio Valley precipitated a state of social and cultural turmoil within Adena. It would seem, from the radiocarbon and cultural evidence for late Adena in the Ohio Valley, that a considerable portion of Adena people remained in the area in coexistence with the new Hopewell invaders.

In northern Kentucky and southwestern West Virginia some groups, less affected by the Hopewell invasion, were able substantially to preserve Adena culture for several hundred years longer, as attested by radiocarbon dates. Still

other groups, especially those in the Adena social and religious hierarchy, would probably have found the situation intolerable and would have chosen, or perhaps been forced, to leave the area. The two Adena sites in Maryland appear to be excellent examples of the presence of ceremonial leaders who gathered their wealth of prized possessions when they fled the Ohio Valley. Deprived of sufficient common labor and perhaps of the authority necessary for the erection of large mounds and public works, these and related groups who pressed on into the Northeast, were no longer able to maintain the more conspicuous elements of the Adena mortuary complex.

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THE COMPOSITE OR "ASSEMBLE-IT-YOURSELF" CENSER: A NEW LOWLAND MAYA VARIETY OF THE THREE-PRONGED INCENSE BURNER

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ABSTRACT

A slit-sided, tubular "incense burner" with three holes in the top, three solid, curved and tapering cylinders called "chili-mashers," and a flat, striated dish called a "griddle" or "*comal*" from sealed Cache B_3 at San José, British Honduras are presented as separate units of a composite Lowland Maya variety of the three-pronged incense burner known from Highland Maya sites. Only the "*comal*" shows signs of burning. The cylinders are removable prongs which fit the holes in the top of the tubular "censer," and the "*comal*" rests on the prongs as the cover on which the incense was burned. Thus, many so-called censers are probably stands or supports rather than receptacles for burning incense. A classification is offered for the several forms of the composite three-pronged censer which is distributed throughout the Maya Lowlands primarily during the Classic period. Since the San José "griddles" shown here to be censer covers are the only "*comales*" claimed for the Maya Lowlands, this identification establishes the pre-16th century absence of the *comal* and the tortilla in the lowland area. Doubt is also expressed that the *comal* forms of Highland Guatemala were used for making tortillas.

THE INSTRUCTIONS for putting together a composite or "assemble-it-yourself" incense burner are simple: take three "curved clay cylinders," an incense burner with three oval holes on the top, and a clay griddle or "*comal*." Insert the "clay cylinders" in the three oval holes of the censer and cover with the "*comal*." The result will be a new Lowland Maya variety of three-pronged incense burner. In order to keep the record straight, however, I would like to present the "assembling instructions" somewhat along the lines recommended recently by R. H. Thompson (1958: 148–50). Since there has been relatively little written to demonstrate the inferential processes employed by archaeologists, I have decided to segment this paper into the four steps suggested by Thompson.

Step 1. Recognition of the indicative potential of the basic data.

Step 2. The explicit formulation of this potential as an indicated conclusion.

Step 3. The evaluation of the tentative conclusion by the introduction of probative data.

Step 4. Presentation of the results of this appraisal as an acceptable inference.

STEP 1

On May 28, 1958 I visited the newly arranged exhibits on Middle America in the Chicago Natural History Museum, expertly installed by Donald Collier. While viewing the exhibit of material excavated by J. E. S. Thompson at San José, British Honduras, I saw a "*comal*-like" dish which showed fire blackening on its striated concave surface. In the same exhibit was an incense burner with a small "fishtail-like" protuberance on the center of the top and three oval holes, also on the top (Fig. 1). There were also on display two solid clay cylinders which according to the museum label may have been used as "pestles for mashing chili" (Fig. 2). At that point an idea occurred to me. Since pre-Columbian *comales* are not known from the Lowland Maya area and since the striated concave surface of the *comal* on exhibit reminded me strongly of the somewhat similar striated and deeply scored, wide-brimmed incense burner covers from the Highland Maya area (Borhegyi 1951a: 109) I began to wonder if the *comal* in question might actually be an incense burner cover that would fit on top of the "chili-mashers" if they, in turn, would fit the oval holes of the censer with the fishtail protuberance.

Since time was short and the exhibit case was locked I was unable to test this hypothesis on the spot. I did however communicate this idea to Collier and together we checked the publication on San José for the provenience of these objects. We found that all, including a third "chili-masher," were discovered in sealed Cache B_3 (Thompson 1939: 125, 126, 153, 154, 186, 187, Figs. 77 *b*, 92 *l*, Pl. 18 *c*, 1). This cache was located in a layer of ash and soot in the southeast interior corner of Room A, Structure B_4, near an altar-like platform (Thompson 1939: 186, Fig. 12). Cache B_3 contained only the "*comal*," the censer, the three clay cylinders, and two obsidian points. According to Thompson (1939: 187), the cache and its contents are of San José IV and V date (Tepeu 2, 3, Late Classic). He also states that the same "*comal*" form was used inverted as a cover over a shallow ring-base bowl in Cache A_5 (close of San José

FIG. 1. Top view of incense burner stand with slit sides, three oval vents on the top, and a "fishtail-like" protuberance on the center top. Stand shows no traces of burning on any part. From Cache B_5, San José, British Honduras; Chicago Natural History Museum, No. 189429. Height to top of platform, 23.5 cm.; height of fishtail protuberance, 3.8 cm.; diameter of top platform, 20.5 cm.; diameter of base, 16.2 cm.; diameter of oval holes, 2.3, 2.3, and 2.2 cm.

IV) and sherds of similar "*comales*," censers, and fragments of three other "chili-mashers" were found scattered in San José IV and V deposits throughout the site (Thompson 1939: 153, 185, 187, Fig. 79 *c*, *d*).

STEP 2

I asked Collier to perform an experiment for me which he did and also most generously documented it with photographs. At my request he removed the censer, "*comal*," and "chili-mashers" from the exhibit and found that the latter "fitted the oval holes very nicely and there seems no question but that is where they belong" (Fig. 3). One of the prongs (Fig. 2) was 3 cm. shorter than the other two so that the cover, that is the "*comal*," does not sit level on them. He also reported that the *comal*-like plate is somewhat blackened on the concave surface and caked with soot on the plano-convex surface. Since the incense burner itself shows no traces of burning this would indicate that the incense, presumably *copal*, must have been burned on the plano-convex surface of the lid (Fig. 4 *b*). The only possible explanation for the somewhat blackened concave surface of the lid may be that this side, too, was occasionally used for burning incense (Fig. 4 *a*). The lack of any sign of burning on any part of the incense burner must have puzzled Thompson who even suggested that if not used as a brazier it may have been employed as a drum (Thompson 1939: 125). However, the fishtail-like protuberance on the top (Fig. 1) is a feature commonly associated with incense burners (Kidder, Jennings, and Shook 1946: 213; Borhegyi 1951a: 111) and would be a most doubtful asset on a percussion instrument. Collier has also informed me that none of the three "chili-mashers," or more properly, prongs, show traces of burning. This suggests that on the San José specimen the incense was burned on the top of the griddle-like cover rather than on the top of the main body of the censer as was done in the case of the Highland Maya type of three-pronged censer (Borhegyi 1951a: 109).

All these data would indicate that the San José specimen when reconstructed constitutes a new and hitherto unrecognized variety of three-pronged incense burner. Since its assemblage consists of several steps, it may be called the composite or "assemble-it-yourself" censer.

FIG. 2. Three solid cylindrical prongs. None of the prongs show any traces of burning. All from Cache B_5, San José, British Honduras; Chicago Natural History Museum, Nos. 189443, 444, 442. Length from left to right: 14.2 cm. (hooked end more flattened), 17 cm., 17 cm.

FIG. 3. The incense burner stand with the three cylindrical prongs inserted in the oval vents on the top.

STEP 3

In order to evaluate the tentative conclusion in Step 2, the following probative data are herewith introduced.

In his description of the San José clay cylinders Thompson (1939: 153, 154) refers to similar "pottery mashers" at Benque Viejo, British Honduras. He illustrates one fragment (Thompson 1940, Fig. 55 *g*) which dates from Benque Viejo IV which is equivalent in time to San José IV (Thompson 1940: 30). Although I have not had an opportunity to examine the Benque Viejo material I can make the following hypothetical case based solely on the report and illustrations. Thompson (1940, Fig. 44) illustrates a pottery fragment from Benque Viejo with a solid "handle" (fishtail-like protuberance) in the top center "with three vent holes symetrically around it." Thompson classifies this specimen and 17 similar sherds as "lids" and dates them to Benque Viejo IV. I think that at least some of them are unquestionably the upper portions of censers and are similar in most respects to the type illustrated by him from San José (Thompson 1939, Pl. 18 *c*, 1) and described in detail in this paper. Although neither the diameter of the "prong" nor of the three "vent holes" is given in Thompson's Benque Viejo report, it is my contention that the prong would easily fit into one of the holes. It might also have fitted into the top vents of another vertical side-flanged incense burner illustrated by him (Thompson 1940, Fig. 8 *c*). The question remains what type of lid or "*comal*" was used on the top of the prongs at Benque Viejo. Wide-brimmed, apron cover lids, similar to the Highland type of three-pronged incense burner covers (Borhegyi 1950, Fig. 6 *c*; 1951, Fig. 5 *c-f*) are reported from Benque Viejo III and IV deposits and are illustrated by Thompson (1940, Fig. 10). They are made from the same unslipped, calcite-tempered ware as the incense burners (Thompson 1940, Figs. 8, 44) and the "pottery masher" or prong (Thompson 1940, Fig. 55 *g*). Since Thompson himself suggests that they were very likely lids of incense burners, there can be little doubt that they complete the picture of the new Lowland Maya variety of three-pronged incense burner at Benque Viejo.

Until recently it was believed that three-pronged incense burners were unknown in the Lowland Maya area (Borhegyi 1951b: 168, map). However, Adrian Digby (1958: 274) has reported finding several hollow plain prongs in association with deeply-scored, incense burner covers at Las Cuevas in British Honduras. The covers (Digby 1958, Fig. 3) are considerably different from the wide-brimmed, loop-handled covers of the Highland type of three-pronged censer since they have two, three, or even four inner loop handles. On the other hand, they are strikingly similar to the vessel of unknown usage reported from Mound F at Cahal Pichik, British Honduras (Thompson 1931: 245, Fig. 10 *b*). The specimen in question is a flaring-sided, wide-brimmed lid with three inner loop handles and a central hole. Digby was kind enough to send me a photograph showing fragments of different types of Late Classic (radiocarbon dates about A.D. 930) incense burners found by him at Las Cuevas. One of the fragments is a censer top with an oval vent. There is a good possibility that this may represent another example of the "assemble-it-yourself" variety of three-pronged censer.

Uaxactún may also be included in the distribution of this newly recognized type of censer. Pit 4, Plaza E, yielded an aberrant "tray-like re-

Fig. 4. The composite or "assemble-it-yourself" incense burner with lid in place. *a*, with concave surface of lid up, some blackening on this striated surface; *b*, with plano-convex surface of lid up, this surface caked with soot. Lid also from Cache B_9, San José, British Honduras. Chicago Natural History Museum, No. 189432. Diameter of *comal*-like lid, 35 cm.; height of rim, 2 cm.; thickness of lid 8–10 mm.

ceptacle" which was thought to be a censer fragment (Ricketson and Ricketson 1937: 239, 240, Fig. 151 *a*, Pl. 79 *d*). There is a circular vent, 20 mm. in diameter and 38 mm. below the rim, in the curved side of the vessel. From a little off center in the interior of the receptacle is a fish-tail-like projection rising at an angle to the vertical axis of the bowl to a height of 46 mm., about 12 mm. above the rim. Only a third of this bowl was preserved. Very likely there may have been two other vents in the missing part as in the case of a similar censer top from Holmul (Merwin and Vaillant 1932: 49, 73, Pl. 31 *c*). If so, could it be that some of the clay cylinders considered by the Ricketsons and Merwin to be figurine arms or legs (Ricketson and Ricketson 1937, Pl. 71 *b*, 1, 2; Merwin and Vaillant 1932, Pl. 32 *bb*, *cc*) were actually solid prongs to fit these vents? The diameter of the vent is certainly the same as that of the San José censer illustrated in this paper (Fig. 1). The only discrepancy in this case is that the Uaxactún specimen is of Chicanel (late Preclassic) date while most of the other "assemble-it-yourself" censers are Late Classic. There is another vessel type from Uaxactún which may or may not have a bearing on this subject. In Tzakol 1, 2, and 3, but primarily Tzakol 2, there are vessels classified by Robert Smith as "bowls with inner inverted feet" (Smith 1955: 127, 131, 132, 147, Fig. 17 *a*, 1–5, 8). Fragments of a similar type of vessel were also found at Copan, Honduras (Longyear 1952: 29, 91, Fig. 35 *i*). According to Smith's (1955, Fig. 17 *a*, 8) restoration of the Uaxactún specimen they probably had four inner inverted hollow feet. Smith suggests that they may have been receptacles for seed with a basket cylinder tied to the four feet and capped by a cover. This type of storage receptacle according to Smith, would keep out rats and let in air. Although he admits the possibility that it might be a type of incense burner something like the three-pronged type (Smith 1955: 127) he questions their use for this purpose because of the lack of any sign of fire blackening. There seems to be, however, some confusion as to which covers were used with these vessels and which were used to cover similar flaring-sided, pedestal-based bowls without the inner inverted feet which do show fire blackening and were undoubtedly used as censers. The problem arises from the fact that both types of vessels and their

covers were made from the same coarse, unslipped ware (Smith (1955: 132, 147, Figs. 17 *a*, 8–14, 6, 7). Some of the bowl covers, moreover, are fire blackened on the interior and raked on the exterior. Is it not quite possible that these deeply scored covers were set atop the inner inverted feet and the incense burned within the hollow cover?

Now that the groundwork has been laid I am ready to introduce the deluxe variety of the composite or "assemble-it-yourself" censer. For this you need a chimney-like, tubular-shaped incense burner which has neither top nor bottom and shows no fire blackening. Select one with nice vertical side flanges and a grotesque face on the front, preferably one representing Tlaloc or Chac. The one from Uaxactún will do very nicely (Ricketson and Ricketson 1937: 282, Pl. 85 *e-g*, Fig. 191). Take a flat-bottomed or pedestal-based bowl with three or four inner handles or inner inverted feet (prongs) and insert it into the top of the incense burner. Put some *copal* in a deeply scored, *comal*-like bowl and place it on the top of the prongs. There will be no fire blackening on the censer nor on the inserted vessel with the prongs or handles. The great advantage of this arrangement is that the receptacle can be changed for each new ceremony thus keeping the main body of the censer as a more or less permanent fixture on temple steps or altars. If you are satisfied with the Uaxactún assemblage, try out one of the small tubular censers from Benque Viejo (Thompson 1940, Fig. 8 *a*), Hatzcap Ceel (Thompson 1931, Pl. 27), Tzimin Kax (Thompson 1931, Fig. 14 *b*), one of the large chimney-like tubular censers from Palenque (Rands and Rands 1957: 148; Rands and Rands 1959; Saenz 1956, Figs. 5–7) or, as a matter of fact, any of the large or small, bottomless and topless, tubular-shaped, vertical side-flanged censers from the Lowland Maya areas in Guatemala, British Honduras, Mexico, or even El Salvador (Boggs 1947: 37, Figs. 1–3).

STEP 4

The newly recognized function of the "assemble-it-yourself" variety of three-pronged censer found in Cache B_3 at San José, British Honduras, seems to suggest the following acceptable inferences:

1. The sealed association of the three clay cylinders, the censer with three oval vents on the top, and the so-called *comal* leaves no doubt that these seemingly different clay objects were meant to be used together. When reconstructed they constitute a hitherto unrecognized variety of three-pronged incense burner called, for the time being and for lack of a better name, the composite or "assemble-it-yourself" variety.

2. The fact that neither the main body of the censer nor the separate prongs show any sign of fire blackening, while the *comal*-like cover is caked with soot, indicates that many incense burners in Mesoamerica may never have been used directly for burning incense but only as supports for the containers in which the incense was burned. Thus a vessel does not necessarily have to show signs of wear or fire blackening in order to be associated with incense burning.

3. This inference leads to a re-evaluation of the basic function of incense burners. Concurring with Thompson (1957: 601, 602), Tozzer (1941: 110, 140, 161), and Smith (1944: 41) incense burners may be classified into three categories:

a. *Incense burners* (in which incense was burned). Most of the two-chambered censers, with or without covers, belong in this category.

b. *Incense burner receptacle supports*. Most of the three-pronged censers made of clay or stone, as well as all hollow, tubular censers without top or bottom probably fall into this group.

c. *Clay idols portraying gods* (or considered to be gods themselves). Either of the first two varieties of incense burners may fall into this category.

For the purpose of this paper only the second category needs further explanation. Incense burner receptacle supports may have been permanent fixtures before mounds, on temple steps, or temple platforms serving in much the same capacity as altars. Priests or worshippers could have brought offerings of *copal* and burned it in the receptacles provided. It may even be surmised that some brought their own *copal* and receptacles. After the ceremony was over and the *copal* had finished burning the receptacle was either ceremonially broken or preserved for future use, depending on the nature of the ritual or the economic status of the worshipper. This ceremony might have taken place in much the same way as can be seen today among the Maya Indians who bring candles to the church and light them before the wooden images of the saints.

4. The presence of the two obsidian points in Cache B_3 at San José (Thompson 1939: 186) would suggest the existence of some kind of sacrifice in connection with the censer from the

same cache. The present day Maya Indians frequently accompany their prayers and rituals with sacrifices of small animals. In most cases the neck of the animal, usually a fowl (turkey) is cut and the blood allowed to drip over the burning *copal*. The two obsidian points in Cache B_3 may very well have been used for similar purposes or for self-sacrifice, thus establishing the fact that this custom was already associated with incense burning as early as the Late Classic period. For Postclassic representations of sacrifices of fowls over incense burners see Dresden Codex 25 and 26 (Villacorta and Villacorta 1930: 60–62).

5. It was thought that the three-pronged censer was absent in the Lowland Maya area with the exception of such sites as Quirigua and Copan (Borhegyi 1951b: 168; 1955). The composite or "assemble-it-yourself" variety of the three-pronged incense burner and its various combinations definitely extends the distribution of such censers into the Lowland Maya area. Although most of the specimens are of Late Classic date the censer-top-with-three-vents from Holmul (Merwin and Vaillant 1932: 73, Pl. 31 *c*) and from Uaxactún (Ricketson and Ricketson 1937, Fig. 151 *a*, Pl. 72 *d*) seems to establish the fact that this type was known in the Lowlands as early as the late Preclassic horizon (Chicanel) or at least during Protoclassic times.

In order to attempt a distribution of all the censers related to the "assemble-it-yourself" variety, we need to establish the following categories:

Type A

Clay censers with three oval vents on the top into which can be fitted three solid cylindrical clay prongs which support a scored or striated dish-like cover (Fig. 4 *a, b*).

Distribution: British Honduras — San José (Thompson 1939, Pl. 18 *c*, 1, Fig. 77 *b*); Benque Viejo (Thompson 1940, Figs. 44, 55 *g*); Las Cuevas (Digby 1958); Guatemala — Uaxactún (Ricketson and Ricketson 1937, Fig. 151 *a*, Pl. 79 *d*); Holmul (Merwin and Vaillant 1932, Pl. 31 *c*); Chipoc (Smith 1952, Fig. 9 *d*); Mexico — Chichén Itzá (two "chili-mashers" excavated by Edward Thompson, purchased by the Chicago Natural History Museum, No. 23585; Collier, personal communication).

Chronological position: Late Preclassic or Protoclassic, Uaxactún, Holmul; Late Classic, San José, Benque Viejo, Las Cuevas, Chipoc; Postclassic, Chichén Itzá (?).

Type B

Clay vessels with three or four inner handles or "inner inverted feet" which may or may not have been inserted into hollow, tubular censer supports and then covered with a scored or striated dish-like cover.

Distribution: British Honduras — Las Cuevas (Digby 1958, Fig. 3); Cahal Pichik (Thompson 1931, Fig. 10 *d*); Guatemala — Uaxactún (Smith 1955, Fig. 17 *a*, 1–5, 8); Honduras — Ulua Valley (John B. Glass, personal communication); Copan (Longyear, 1952: 92, Fig. 35 *i*); Mexico — Palenque (Rands, personal communication).

Chronological position: Early Classic, Uaxactún; Late Classic, Copan, Las Cuevas, Cahal Pichik, Palenque.

For the distribution and chronological position of related "Rimhead vessels" see Borhegyi (1951a: 115–8).

Type C

Small or large tubular, top-and-bottomless, clay censers adorned with vertical side-flanges and grotesque modeled faces which may or may not have supported vessels with three or four inner handles or "inner inverted feet," or simple flaring-sided bowls.

Distribution: British Honduras — Vaca Falls, Starkey Hill (Gann 1934: 53, Fig. 6); Hatzcap Ceel (Thompson 1931, Pl. 27); Tzimin Kax (Thompson 1931, Fig. 14 *b*); Las Cuevas (Digby 1958, correspondence); El Salvador — Hacienda Chanmico (Boggs 1949, Figs. 1–3); Guatemala — Tikal (Coe and Broman 1958: 39–40, Fig. 13); Uaxactún (Ricketson and Ricketson 1937; Pl. 85 *e-g*); Paso Caballos (Smith 1944: 41, Fig. 2 *a-e*); Piedras Negras (Coe and Broman 1958: 40); Mexico — Palenque (Saenz 1956, Pl. 5–7; Rands and Rands 1957: 148); Zopo Cave, Tabasco (Blom and La Farge 1925, Figs. 122–4).

Chronological position: Early Classic, Uaxactún; Late Classic or later (?), all the rest.

R. H. Thompson has called to my attention the fact that representations of incense burners in the Maya Codices frequently show tall tubular-shaped censers with smoke and fire issuing from them in the form of black spirals. Some of these censers are drawn in such a way as to suggest that the incense is being burned in a flaring-sided bowl which has been set into the upper portion of a double-chambered censer — thus suggesting that the censer itself may have served only as a stand. See Codex Tro-Cortesianus 60, 107, 108 (Villacorta and Villacorta 1930: 344, 438, 440) and Dresden Codex 27, 28, 35 (Villacorta and Villacorta 1930: 64, 66, 68).

6. To date, the only pre-Columbian "*comales*" recorded from a Lowland Maya site are those clay "griddles" reported by Thompson at San José (Thompson 1939: 126, 185, 186, Figs. 77 *b, d*; Smith 1955: 100). All sherds had interior and exterior striations. However, Thompson, himself, expressed some doubt that these "griddles" were used for the making of tortillas since "*comales*" are not mentioned by Landa, and Remesal definitely states that they were not used by the Chol Mayas. Early missionaries at Campeche similarly fail to describe them (Thompson 1930: 95, 96; 1939: 126; also Tozzer 1941: 90). Even today, the clay *comal* or *xamach* is seldom used or made by the Lowland Maya (R. H. Thompson 1958: 109, Fig. 34 *a-d*), and has been largely replaced by the flat, iron griddle (Thompson 1930: 99). The newly recognized function of these scored "griddles" as covers for the "assemble-it-yourself" censer type establishes with some finality the absence of *comales* in the Lowland Maya area before the 16th century.

This however opens up another intriguing possibility. What proof do we have that the so-called *comales* of the Highlands were used only for baking tortillas or roasting cacao beans, chile, seeds, or nuts in preconquest times? Many of the flattish or round-sided vessels classified as *comales* from Highland Maya sites are either striated or raked on the exterior, interior, or both. While there seems to be no practical value to these striations for the baking of tortillas, there does seem to be reason for them in connection with the burning of incense. Also the scoring of these specimens is in most cases too crude to have served a merely decorative purpose. The striations may therefore have served to provide a surface to which some aromatic adhesive substance such as *copal* or pine resin could be "keyed." Digby (1958: 274) noted that a thick, compact layer of partly carbonized material was still adhering to a sherd from a deeply-scored lid from Las Cuevas. So far he has not been able to analyze this substance, but a small fragment heated in a Bunsen-burner flame gave off an aromatic odor. It could therefore be suggested that most, if not all, striated or scored *comal*-shaped plates in the Highlands were not griddles but served in connection with three-pronged incense burners. There is still the question of the function of the smooth, unstriated clay vessels classified as *comales*. Those from Kaminaljuyu (Esperanza phase) are rather crudely manufactured, round-sided vessels with two opposite handles and well-smoothed interiors (Kidder, Jennings, and Shook 1946: 208, Fig. 200 *g*, *h*). These and all the similar Late Classic Amatle-Pamplona "*comales*" range in depth from 5 to 7 cm., and in diameters from 19 to 22 cm. These "*comales*" would be very unhandy from a purely practical point of view for making tortillas, and are no longer believed by Kidder (who read this paper in manuscript) to have served that purpose. Identical vessels are still manufactured and used today in Highland Guatemala by both Indians and Ladinos and are called *torteras* or *sartenes*. They are rarely, if ever, used for making tortillas but primarily for frying or stewing. Could it be that the flat clay *comal* used today throughout Mesoamerica for making tortillas is a post-16th century introduction from Mexico, or even from the Old World along with the flat, round tortillas, itself? Certainly, flat cakes made from wheat flour, sugar, and oil, and called *tortas* have been known in southern Spain since Phoenician times.

7. Since the solid, unslipped clay cylinders from Cache B_5 have been proved beyond doubt to have been prongs for three-pronged censers and not "chili-mashers" a re-examination of all such pottery "mashing implements" is in order.

8. The possibility that bowls with three or four inner inverted feet, or effigy heads, may have been inserted in tubular, top-and-bottomless, censer supports and then topped with cover-like plates necessitates a re-study of all such vessels and their associations. Although it has already been suggested that such "rimhead vessels" (Borhegyi 1950: 63–65; 1951a: 115) were in some way related to the three-pronged incense burners, no functional relationship was established due to the lack of any signs of burning on them. If they were used to support offering plates, however, they may have served as incense burner receptacle supports, in much the same fashion as many of the three-pronged incense burners. This would also explain their lack of fire blackening. The fact that they are contemporary with the Preclassic and Late Classic three-pronged censers but smaller and simpler than these, suggests that they may have been used as house altars or for lesser ceremonies.

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THE SMELTING OF SULFIDE ORES OF COPPER IN PRECONQUEST PERU

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ABSTRACT

Doubts that the Peruvian Indians could smelt copper ores in pre-Columbian times are unjustified, although archaeological evidence for the very effective wind furnaces described by early chroniclers is scanty. Oxide and carbonate ores from shallow deposits are more simply smelted than the sulfide ores, which required roasting of the crushed ore prior to reduction at a higher temperature. New evidence for the smelting of sulfide ore comes from chemical analysis of an ingot from the Province of Ica, and suggests the need for restudy of older analyses and a search for new prehistoric metallurgical evidence.

A CRUDE copper ingot or cake (Fig. 1), said to come from "La Legua," Valle Ingenio, Province of Ica, not only raises anew the unresolved question of preconquest smelting, but shows that mining techniques were more advanced than generally believed. More important, it indicates that the man who made it had somehow hit upon the relatively complicated processes involved in smelting sulfide ores of copper, such as chalcocite (Cu_2S), covellite (CuS), and the mixed sulfides of iron and copper, chalcopyrite ($CuFeS_2$). These and other chemical formulae used in this article must be understood to refer to "pure" ores. The fact of the matter is that in nature various impurities, such as silver, lead, iron, nickel, bismuth, arsenic and antimony, may be present in copper ores and in metal objects produced from such ores (Nordenskiöld 1921: 135–9). Before going on to consider our ingot and some finished Andean copper and bronze objects in which sulfur is present as an impurity, it may be in order to review briefly what is needed in the way of equipment and temperatures to smelt copper ores.

It is commonly accepted that man was able to *melt* native metals long before he could *smelt* minerals to extract metal from something that was not a metal to start with. Whatever doubts may have been expressed about the smelting of copper ores in the New World before the Spanish conquest, no one has ever questioned the fact that native copper was melted and cast. This is an important fact to bear in mind when doubts are raised whether the early pre-Columbian workers could achieve with primitive means the temperatures necessary to smelt copper ores. To fuse native copper requires a temperature of 1083° C. or 1981.4° F. No smelting process for any copper ore calls for a higher temperature, and for most a considerably lower temperature will suffice.

In the formation of the copper-bearing minerals of Peru (Raimondi 1878: 82–3), as indeed elsewhere in the world (Forbes 1954: 585; Thompson 1958: 3), the shallower deposits or secondary ores tend to weather and become oxidized. This accounts for an oxide ore like cuprite (Cu_2O), the brilliantly colored carbonates, malachite ($CuCO_3$, $Cu(OH)_2$) and azurite ($2\ CuCO_3$, $Cu(OH)_2$), a silicate like chrysocolla ($CuSiO_3$, $2\ H_2O$), or an oxychloride like atacamite ($Cu_2Cl(OH)_3$). The last mentioned ore is found in coastal Peru and Chile, and Raimondi notes that the presence of chlorine is due to the action of sea water in its formation. Barba (1925: 165), who wrote the great early classic on Andean metallurgy in 1640, calls these secondary ores of copper *pacos*, "whether they be green, blue, orange, or of whatever color; all those that were not steely or mirror-like."

As the depth of mining increases, however, the oxychloride, oxide, and carbonate ores disappear, and the sulfide ores of copper mentioned above in the first paragraph begin to appear. These are harder, and have a distinctly metallic luster. Barba calls them *negrillos*, and describes them as being steely or mirror-like in appearance.

In connection with our ingot or cake from "La Legua," it may be significant that Raimondi (1878: 90) reports that chalcocite, covellite, and chalcopyrite, three of the principal sulfide ores of copper, are present in that part of Peru. However, evidence that any of these ores was mined there in preconquest times has not been reported; nor, according to our informants, is any such evidence likely to be found, due to the continuous working of productive deposits.

The reduction of oxide and carbonate ores of copper by primitive means presents no serious problem. Thompson (1958: 3), citing the outstanding English metallurgist, Gowland, has stated that the charcoal reduction of copper oxide or cuprite commences at 500° to 600° C., or about 932° to 1112° F. Referring to the famil-

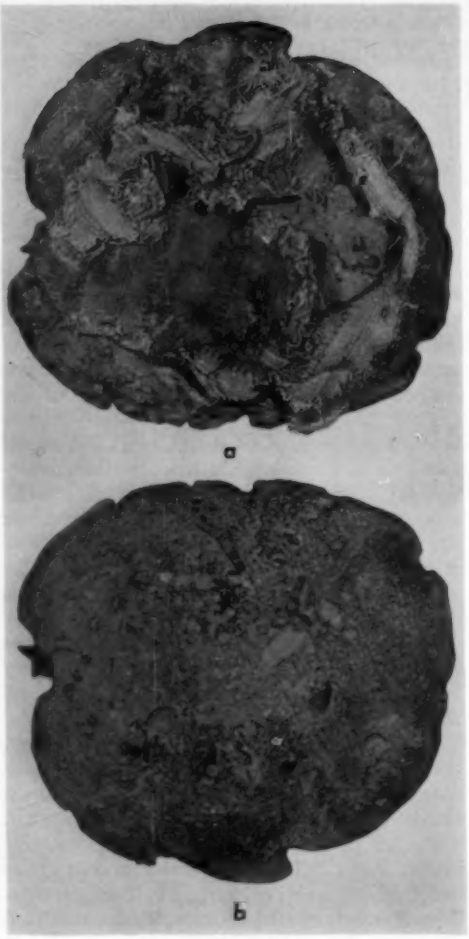

Fig. 1. Copper ingot, Province of Ica, Peru. *a*, side with adhering cotton textile; *b*, other side showing surface pitted with air holes.

iar "camp fire" theory of the accidental invention of smelting, Thompson states, "There is nothing that I know which precludes the possibility of a first reduction of a copper carbonate ore having occurred in a domestic fire drawn up by a hot, dry wind." However, low temperature reduction will give as an end product a discouraging, spongy mass of copper with an admixture of charcoal and impurities in the ore. It is possible, but very difficult, to make this mass coherent by hammering. Coherence can be brought about more easily by fusion, by raising the temperature to the melting point of copper (1083° C.). At that temperature the heavier molten copper will separate and sink to the bottom of the furnace under a surface layer or scum of unfused impurities. The addition of a flux will aid in separating the fusible copper from the surface slag, and it is interesting to find Barba (1925: 165) in 1640 suggesting "copper matte" from a prior smelting operation, or "sand" (silica), or "some white stones that melt easily in the fire" (quartz or possibly limestone) for that purpose. To achieve the requisite temperature for fusion calls for a strong natural draft or an artificially produced one, which leads to a mention of the primitive, but efficient, wind furnaces in the Andean region.

The *huaira* or *guayra* (the Quechua root for "air" or "wind") was in common use in that region before the Spanish conquest and for a considerable time thereafter, according to the accounts of the early chroniclers. The most authoritative is that of the metallurgist-priest, Barba, who also gives a drawing (1925: 139–41). In brief, it was a shaft furnace made of terra cotta, usually about a meter in height. It had a number of small holes in the wall for good draft, and on the outside in front of each hole was a slightly cupped platform on which charcoal was kept burning to heat the air entering the furnace. The charge of ore and charcoal was placed inside the furnace through the open top, and ignited. These furnaces were placed on windy slopes or hillsides to take advantage of the powerful up-draft, and Cieza de León (1945: 271), who wrote in 1553, pays high and somewhat quaint praise to their efficiency. Having noted that there were some silver ores at Potosí which resisted the repeated efforts of "great masters" using the bellows introduced by the Spaniards, he goes on to say that "in the end, as men are able to meet the problems in this life, they found a way to extract this silver with the strangest invention in the world," the ancient wind furnace of the Indians.

Boman (1908: 135, 189, 537–9) had the good fortune to find a prehispanic mining and metallurgical site near Cobres in northwest Argentina, and exploited his find to the full. In that locality he came upon copper mines worked by the Indians, *marays* or heavy rocker stones used to grind the ore, fragments of wind furnaces, slag, and bits of smelted copper. Samples of the ore, slag, and copper were collected, and later analyzed. The ore was a chrysocolla, a silicate with

a high content of iron as an impurity. The silica, of course, served as a built-in flux; and from an ore that contained roughly three to four times as much iron as copper these early workers were able to recover a metal that was 98.74% copper, with 0.92% iron and 0.31% lead as impurities.

With the exception of Boman's find and appreciation of what he had found, archaeological evidence of the wind furnace lags behind the descriptions in the chronicles of Cieza de León (1553), Ramirez (1597), Ovando (1605), Barba (1640), and Cobo (1653), all collected and quoted verbatim in Boman (1908: 546–52). Granting that, since the wind furnace of the Indians continued to be used well into Colonial times, dating may not always be easy, we submit that the apparent lack of archaeological evidence does not justify the doubts that have been expressed whether copper ores were smelted before the coming of the Spaniards. The metallurgical evidence in published analyses of known pre-Columbian copper and bronze objects cannot be ignored; and it indicates that in many cases the metal was the product of smelting operations, not native metal. The precise equipment used is something that can be established only by the archaeologists. For the charcoal reduction of oxide or carbonate ores of copper it need not have been anything as elaborate as the wind furnace described by the chroniclers and found by Boman. A trench or a pit dug on the side of a hill where there was a strong updraft would have sufficed for the most primitive sort of smelting. A more efficient job could have been done with a clay crucible, charcoal, one of the fluxes ready to hand (such as sand or limestone), and a good natural or artificial draft. Bellows were unknown in America before the conquest, but blowpipes were used and have been found archaeologically.

The smelting of sulfide ores of copper is relatively more complicated, but still entirely possible with the rudimentary means available to the preconquest workers. The first step, whether the ore be a simple or a mixed sulfide, is to set out a pile of crushed ore mixed with charcoal fuel, light it, and "roast" off the sulfur in the open air. All that is needed in the way of temperature is sufficient heat to ignite the sulfur and burn it off, 350° C. or more depending on the composition of the ore and how finely it is crushed. Too much heat is fatal, for the metal in the ore will begin to fuse, the roasting action will come to a stop, and the elimination of the sulfur will be prevented (Thompson 1958: 4; compare Cheng and Schwitter 1957: 361–2).

With a simple sulfide ore like chalcocite, once the sulfur has been burned off as sulfur dioxide (SO_2) and the copper sulfide thus converted to copper oxide, the oxide can be reduced with charcoal, described above (Thompson 1958: 4).

How the Indians happened on the roasting of sulfide ores may never be known. Obviously they knew nothing of the chemical reaction involved, which was to drive off the volatile elements in the ore (such as sulfur, arsenic, and antimony) in the form of gaseous oxides, and bring about a partial or complete oxidation of the metal (Guillet 1948: 10–12, 62). If one is tempted to speculate on the discovery of roasting, it does not require a fertile imagination. Two facts already mentioned are (a) the necessity for relatively little heat, and (b) the metallic luster and appearance of sulfide ores. However much Triana (1951: 145) may have been criticized on other scores, his guess on this point appears as good as any that is likely to be made:

> Probably an accident put a metallurgical method of producing copper into the hands of the Indians, availing themselves of *marmaja* (chalcocite or cuprous sulfide), a very common substance in the territory. The metallic appearance of this mineral might have suggested to the workers the idea of melting it, as they did with gold. Upon submitting it to the operation in their crucibles they must have observed that it burned, giving off unbreathable fumes and leaving a dense, dark residue that, upon being remelted with charcoal, produced red copper for them. [Translated from the Spanish.]

Turning from chalcocite to a mixed sulfide like chalcopyrite ($CuFeS_2$), the elimination of the iron presents an additional, but not insuperable, problem. Roasting will drive off some of the sulfur and other volatile impurities, leaving the ore partially oxidized and partially desulfurized. Fortunately for the early workers, iron has a great affinity for oxygen while copper has a great affinity for sulfur (Guillet 1948: 11). Consequently where, as here, insufficient oxygen is present, it is attracted to and unites first with the iron, while the insufficient amount of sulfur present unites by preference with the copper. If the ore is in a silica-bearing rock or if a siliceous flux, such as sand, is added to the molten charge in the first smelting after roasting, the silica combines with the iron oxide to make a ferrous silicate slag. This slag with its impurities floats to the top of the molten charge while the heavier copper matte sinks to the bottom of the furnace. When tapped off the molten material separates into two layers, slag with unfused impurities

above and cuprous sulfide matte below. Upon cooling the matte is physically separated and dead roasted to convert most of the sulfide into an oxide, which is reduced with charcoal. Several smeltings may be necessary. When, in the final stage, air blows over the molten mass, as would occur in a wind furnace, any remaining impurities are oxidized and likewise a part of the copper may be oxidized. For that reason great care must be exercised to prevent the formation of too much cuprous oxide, which causes the metal to become brittle and unworkable.

No new technical improvements upon the basic principles described above appear to have been made until the 19th century. Electrolytic refining was introduced in 1867, and in 1880 what is known as "blister copper" was first produced by blowing a blast of air through the molten metal in a converter to oxidize impurities (Guillet 1948: 66–7). In addition to these modern advances, it is also doubtful whether the early pre-Columbian workers had discovered a practice that was common in the Old World, "poling." It consists of stirring the molten copper with a pole of green wood, which releases volatile carbon compounds that in turn reduce any oxide present. The evidence is not clear, but it seems likely that had the Indians hit upon this practice, a meticulous reporter such as Barba would have mentioned it.

In classical times in the Mediterranean area some of the sulfide "matte" recovered during the process is said to have been returned to the furnace as an ancillary flux (Forbes 1956: 50). Barba (1925: 165) reports that the same practice of returning *crudio* (or "matte") to the furnace was followed in early Peru, and the analyses of pre-Columbian objects produced from what must have been the smelting of sulfide ores tend to confirm that a series of repeated smelting operations were carried out to extract the copper. The incredibly high degree of purity of the metal cannot be accounted for in any other way.

What has been said here need not strike the average reader as too complicated for credence. Forbes (1956: 50), writing about the smelting of sulfide ores of copper in classical antiquity, has observed that "Roasting the ore, smelting the roasted ore, a second and possibly a third resmelting, and the final refining were not always separate operations; some were often carried out simultaneously and even in the same furnace." There is no reason to believe that that observation does not apply with equal force to precon-quest Peru. As Thompson (1958: 5) has said, with reference to the steps we have described,

> There is nothing in this sequence of operations, which makes any special demand on equipment, the temperatures are no higher than that required to melt native copper, and there can be little doubt that it was in this way — as, in the broadest outlines, it still is — that the copper was extracted.

Going back to the ingot that prompted this study, it is one of a group of 22 assembled by Pablo Soldi in the vicinity of "La Legua" in the Province of Ica. All were found in a region of that province where many finished objects, of metal and other substances, have come to light, giving rise to the impression that it may have been a center for craftsmen. One could do with more precise information than Soldi was able to supply. He believes, and we are inclined to agree, that these ingots were part of the raw material kept on hand there to fabricate implements or ornaments as the occasion arose.

Our ingot has a mean diameter of 14.5 cm., and weighs 1100 grams. The surface is pitted with air holes caused by gases in the molten metal, and shows surprisingly little corrosion. The walls of the holes drilled to get samples for analysis show a bright, homogeneous surface about the color of a new penny. This particular ingot was selected and sent to Easby for study, because it was the only one of the group with a textile fragment adherent (Fig. 1 *a*) and that circumstance offered some hope of an approximate dating. The textile fragment was examined under magnification by Junius B. Bird, who reports that it is an all cotton, warp-faced, plain weave with alternating plain and barred stripes. Barring occurs frequently in simple late textiles (probably 13th to early 16th century). Bird's report also states that the yarn is "doubled," having been spun with a Z-twist and doubled with an S-twist. That type of doubling, although not unknown in the north, is dominant on the coast from Ancón south.

Following the textile examination some filings from the ingot were sent to the laboratory of Lucius Pitkin, Inc. in New York for a qualitative spectrographic analysis. That showed the filings to be predominantly copper with iron, nickel, silver, and antimony present in estimated amounts of 0.001% to 0.009% each, and tin in an estimated amount of 0.0001% to 0.0009%.

Thereafter the ingot was sent to Caley, who took a sample weighing 1.1414 grams and ran a quantitative chemical analysis (Table 1).

TABLE 1. RESULTS OF QUANTITATIVE CHEMICAL ANALYSIS

	Per Cent
Copper	97.77
Iron	1.44
Nickel	0.01
Sulfur	0.18
Total determined	99.40

In addition oxygen was present as cuprous oxide, the proportion estimated by difference being 0.60%. No other elements in proportions as high as 0.01% were found. The difference between Caley's results and the spectrographic analysis as far as the iron content is concerned, and possibly to a slight extent the nickel content, may be due to the fact that Caley took a considerably larger and more representative sample from the ingot than was used for the spectrographic analysis. *The sulfur and the oxygen which he found could not have been detected by a qualitative spectrographic analysis.* This means that the many reported spectrographic analyses of Peruvian and Bolivian copper and bronze objects are inconclusive on the question whether a sulfide ore of copper might have been used to produce the metal in them.

The sulfur content disclosed by Caley's analysis is highly significant. It shows that this ingot or cake was not produced by melting native copper nor by smelting an oxidized ore, but must have been the result of smelting one of the sulfide ores of copper mentioned earlier. The analytical results as a whole are similar to those that have been obtained on samples of modern "blister copper," the metal produced when copper matte is blown in a converter (see Lyman 1948: 2). The Indians had no such equipment, so to have achieved this result bespeaks either greater technical competence than generally recognized or exceptional good luck. Certainly this aspect of pre-Columbian technology deserves more study.

Most published analyses to date have been concerned primarily with the tin content of preconquest bronzes. Nevertheless there are a respectable number of cases where sulfur has been reported present in a measurable proportion (Table 2). It has been suggested that some of the older analyses should be rerun, using modern analytical techniques. Also, to the extent that samples can be taken from pieces of known provenance without defacing them or that fragments of no value for exhibition purposes may be used, more quantitative chemical analyses should be run.

All the objects in Table 2 are from highland sites, but in the present incomplete state of the record it would be unsafe to say that sulfide ores of copper were smelted only in the highlands and not in coastal Peru. Boman made that sort of an error in 1908 when, on insufficient evidence, he concluded that sulfide ores were smelted only by the great builders at Tiahuanaco.

TABLE 2. ANALYSES OF METAL WITH MEASURABLE PROPORTION OF SULFUR

Object	Provenience	Per Cent Copper	Per Cent Tin	Per Cent Iron	Per Cent Sulfur
1. I-shaped cramp	Tiahuanaco	95.65		1.63	2.55
2. I-shaped cramp	Tiahuanaco	98.64		0.43	0.87
3. Agricultural implement	Chepen	99.62	0.015		0.265
4. Drill (?)	Isl. Titicaca	94.96	4.98		0.53
5. Ax	R. Pampaconas	88.06	12.03	0.08	0.35
6. Ax	R. Pampaconas	96.44	3.36	trace	0.23
7. Ax	Rosalina	93.94	5.58		0.08
8. Tumi	Machu Picchu	94.26	4.82	0.32	0.23
9. Ax	Machu Picchu	93.70	5.01	0.87	0.44
10. Ax	Machu Picchu	94.41	5.12		0.29
11. Tumi	Machu Picchu	96.26	3.67		0.18
12. Ax	Machu Picchu	95.63	3.99		0.40
13. Chisel	Machu Picchu	93.90	5.53	0.06	0.15
14. Tumi	Machu Picchu	95.35	4.22		0.20
15. Tumi	Machu Picchu	90.09	8.99		0.13
16. Tumi	Machu Picchu	92.55	7.14		0.20
17. Tumi	Machu Picchu	94.52	5.12	trace	0.29
18. Thin blade	Machu Picchu	91.24	8.89	trace	0.37
19. Ax	Samaipata	97.80	0.70		0.50

Nos. 1 and 2 from Boman (1908: facing 869); Nos. 3–7 from Mead (1915: 22, 28, 41); Nos. 8–18 from Mathewson (1915: 531); No. 19 from Nordenskiöld (1921: 167).

The facts that our ingot came from southern coastal Peru and that it was found in association with a more or less typical south coast textile are not necessarily proof that it was smelted locally from local ores. We know from Raimondi that three of the principal sulfide ores are present in that region, and Soldi has stated orally that sulfide ores of copper are found nearer to the surface there than in the highlands; but more evidence is needed. That means more archaeological investigation, and many more quantitative chemical analyses. It is to be hoped that an exhaustive search will be made for slag and other evidence of smelting in the region from which our ingot came, as well as in other parts of Peru. Also we hope that Soldi may prevail upon one of the commercial producers of copper in Peru to analyze the other ingots in the group. That type of cooperation between industry and scholarship exists in other countries and deserves to be emulated.

Mead (1915: 28) gives one analysis, after Loeb and Morey, that seems to warrant a post script. It concerns a spear point from the ancient Chimú capital, Chanchan, and shows 97.43% copper, 2.14% arsenic, "little" sulfur, and traces of iron, and possibly lead. This is one of the analyses which should be rerun. The probabilities are all in favor of local smelting and local manufacture. In Chanchan, which covers more than ten square miles of adobe construction in ruins with ten distinct districts laid out on a rectangular plan, one district contains the remains of what were unquestionably large scale metallurgical operations. Squier (1877: 164) describes the ruins of ancient furnaces with slag clinging to the walls and a large slag bed near by, Lothrop (1938, Pl. I *d*) illustrates the remains of the furnaces, and Easby visited the site briefly in 1951. By pooling all their evidence, one is reasonably safe in hazarding a guess that the adobe furnaces were shaft furnaces. We have been unable to find anything to substantiate Squier's statement that the slag "is proved on analysis to be mainly of copper and silver ores," but there is no reason to believe that such will not prove to be the case if and when representative analyses are run. Despite its size and importance, Chanchan has had little or no professional attention. It has been worked over by treasure hunters since the 16th century, and in more recent times it has been subjected to the devastating effect of very heavy rains at about 25 year intervals. It may be too late to recover any worthwhile evidence; however, this statement should not and cannot be made in the present state of the record. This is the only known pre-conquest metallurgical and metalworking center on such a grand scale and, at the risk of laboring the obvious, it would seem to be the logical place to begin a thorough investigation of the problem posed in this paper.

If further studies are undertaken to extend the frontiers of our knowledge of pre-Columbian technology of metals, it is to be hoped that the words of Thomas T. Read (1934: 389), written almost a quarter of a century ago, may be kept in mind: "To arrive at the truth archaeologists and technologists need to work together, lest separately they go astray."

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NEW LIGHT ON THE MIDLAND DISCOVERY

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ABSTRACT

Additional excavation in 1955 confirmed the previously reported stratigraphic sequence at Midland, Texas. Within the gray sand, which had yielded a fragmentary human calvarium, there were found additional flint flakes, burned rocks, and animal bones. Besides several small mammals, a four-horned antelope (probably *Capromeryx*) was present in the gray sand; horse bones occurred in the gray sand and overlying red sand. These finds make the two radiocarbon dates published in the 1955 Midland report, giving an age of about 7000 years to the gray sand, even less acceptable than previously thought. Experimental dating by the uranium daughter products technique suggests an age of about 20,000 years for the gray sand, somewhat excessive in terms of cultural correlations although supported by a single radiocarbon date and not unreasonable for the faunal assemblage. Ten radiocarbon dates from the Midland, Blackwater Draw, Lubbock Lake, and Plainview sites are discussed in terms of three possible correlations of the geological, climatic, faunal, and cultural events in the Southern High Plains.

THE GENERAL conclusions in *The Midland Discovery* (Wendorf, Krieger, and Albritton 1955) are as follows:

1. The human skeletal remains, consisting of a nearly complete calvarium and certain other fragments found on the Scharbauer ranch five miles south of Midland, Texas, were associated with a pale grayish-brown sand deposit labeled the "gray sand." This sand was partially exposed near the bottom of a bowl-shaped depression or "blowout," scoured out of a complex series of sands by wind action.

2. Excavations conducted to establish the stratigraphic order of these sands disclosed that the gray sand overlay a white lacustrine sand and underlay red and tan aeolian sands.

3. The white lacustrine sand had been deposited in a small lake or sluggish stream. It contained abundant fossils of late Pleistocene age, and reflected a period of pluvial conditions corresponding to one or more of the Wisconsin glaciations. The overlying red aeolian sand also contained occasional fossil remains of now-extinct animals, but its migration over the site suggests a climate at least as arid as the present, and probably more so. The red sand was identified as a unit in the Judkins formation, a series of rust-colored fossil dunes which mantle a large area in western Texas and adjacent New Mexico.

4. In the vicinity of the Scharbauer site the red sand is somewhat indurated and resistant to erosion, and where its original surface is intact, it is humus-stained for a depth of at least 2 feet. This humus stain reflects a period of much greater moisture than the present, with abundant vegetation in contrast to the present thin grass and yucca.

5. Except where exposed by recent wind action, the red sand is overlain by large dunes of light golden-brown sand, labeled the "tan sand." This belongs to the Monahans formation which, like the Judkins, covers many thousands of square miles in western Texas and New Mexico. The light-colored Monahans sand probably was derived from the Judkins sand by reworking. The animal remains in it are from species that still live in the area. The Monahans formation includes two members: an older one of dunes now fixed by scanty vegetation; and a younger one of presently-active sand reworked from the older member. The older member represents a period of extreme drought and sand migration well in the past, but the contact between the two members is not marked by any significant depth of humus stain.

6. Since it had been established that the gray sand with the human skeletal remains is younger than the white lake deposit but older than the overlying red and tan sands, relative dating of these deposits depended on two kinds of associated remains: fossils and artifacts. The fauna identified from the white sand includes the following extinct Pleistocene species: horse (at least two species), bison, peccary, camel, four-horned antelope, mammoth, sloth, and dire wolf. Many of these remains were found in articulation and must represent animals that lived while the white sand was being deposited under water. Fossils in the gray and red aeolian sands were few and scattered, and many are so small that they could have been blown from the exposed white sand into these later deposits after the lake or stream had disappeared. Other fossils in the aeolian sands were found articulated and they must represent animals that survived in the area while these deposits were being laid down. Among these were horse and turtle.

7. Cultural materials from the white sand include a fragment of horse bone on which are

numerous scratches seemingly made by man with cutting tools; one flint flake possibly in place; and numerous flint flakes which appeared to be weathering out of the white sand even while the excavations were made. Wendorf's first excavations, and particularly those of Sellards soon after, resulted in the discovery in the gray sand of flint flakes and scrapers, pieces of burned caliche probably used for lining hearths, and small scraps of burned bone. No cultural material of any kind was found *within* the Judkins red sand. However, in all the blowouts where wind erosion has removed the relatively loose Monahans sands and exposed the humus-stained original surface of the red sand, a variety of artifacts has been found, as well as thousands of burned caliche rocks, the latter often occurring in small oval areas undoubtedly representing stone-lined hearths. Of the five blowout localities described in the Midland book, four had produced Folsom points from the exposed surface of the red sand. These Folsom points included not only the "classic" fluted form, but thin specimens of about the same shape and dimensions which were fluted on but one side or unfluted (doubtlessly because they were too thin for fluting). We referred to these as "unfluted Folsom" points, but we suggest that hereafter they tentatively be called "Midland points." In such a tentative type we might include specimens illustrated by Wendorf, Krieger, and Albritton (1955, Figs. 12 *1, 4*; 16 *19, 25, 27–30, 32*; 17 *35, 36*; 21 *58*). The point considered as the approximate ideal is shown in Figure 12, Number 1 of the 1955 report. While so few specimens are insufficient for estimating dimensions for this type, those from the Scharbauer site suggest approximate ranges as follows: length (two complete specimens), 1.19–2.25 inches; maximum width, 0.70–1.00 inch; base width, 0.50–0.80 inch; thickness, 0.10–0.21 inch. In addition to its generally small size and notable thinness, the type would be characterized by bases similar to those of Folsom fluted points: a concavity ranging from shallow to deep but presenting a single curve which makes the corners sharp; and at times there is a small "nipple" protruding from the center of the base. On some of our Midland points this nipple is barely perceptible. We cannot yet say what the distribution of this tentative type is, or how closely it corresponds to that of Folsom points.

Although three of these "unfluted Folsom" or "Midland" points were found in the same blowout as the human remains, we concluded that they probably had dropped to that position after wind action had removed the red sand. It seemed improbable that Folsom points — fluted or unfluted — could have existed both before and after the significant climatic changes reflected in the migration of the red sand dunes and their subsequent stabilization.

Stemmed, notched, and barbed projectile points also were found in these blowouts, along with the Folsom and Midland points. This suggested that these types either survived in this area far later than in adjacent regions, or, more likely, that the overlying tan sands had shifted from time to time, covering later artifacts along with them. Then, as the tan sands shifted again, in more recent times, all of these artifacts appeared together on the red sand surface, some of them perhaps dropping down from higher positions in the tan sands.

8. When the human skull was first discovered by Keith Glasscock it was being exposed by wind erosion. There were no indications of a burial pit or other disturbance. On the other hand, particles of gray sand adhered to the skull and were covered by a calcium deposit; and the skull appeared to be fully as fossilized as the Pleistocene faunal remains from the white and gray sands. The real proof, however, of the skull's primary association with the gray sand rested upon an exhaustive series of chemical analyses which showed conclusively: *a*, that these fossils differed greatly in their chemical content from modern animal bones; *b*, that fossils from within the white, gray, and red sands all were similar in their chemical content and therefore essentially contemporaneous; and *c*, that the human fossil was unquestionably contemporaneous with the Pleistocene fauna from this site. For the results of further chemical tests, see Oakley and Rixon (1958).

9. We concluded that the minimum age of the human skull would equal the age of the Folsom culture plus whatever time before that was needed for the migration of the red sand dunes and their stabilization by vegetation.

10. The two radiocarbon age determinations made by the University of Michigan — 8670± 600 years for the white sand and 7100±1000 years for the gray sand — were believed to be too low for several reasons: *a*, the unburned fossil bones and tusk were exceedingly difficult to process, yielding very small amounts of organic carbon in which even a small amount of

organic contamination could have seriously affected the dating of such inadequate samples; *b*, we could not reconcile these dates with the position of the deposits in relation to the local Folsom artifacts and the Folsom date of about 10,000 years ago at Lubbock; and *c*, these dates could not easily be reconciled with what was known about Pleistocene faunal extinctions in the Southern High Plains — in particular, the consistent evidence for the extinction *in this region* of all of the large Pleistocene mammals except *Bison antiquus*, and possibly the dire wolf, before Folsom times.

Excavations in the Fall of 1955

The radiocarbon datings raised the question of whether they might actually be essentially correct — that is, that something was wrong with the previous observations and interpretations. A search for more artifacts in the gray sand, we hoped, might reveal some of more diagnostic value, such as projectile points. Perhaps the "Midland points" found previously on the floor of the blowout near the skull had not, after all, dropped to this position by undercutting of the overlying red sand, but like the skull had been exposed by wind deflation of the gray sand. Perhaps, also, the red sand migration over this *particular locality* was, after all, a radical but localized event, not calling for any continental or fundamental climatic change to account for its being moved over the gray sand from somewhere nearby. All these matters had already been considered in detail by the writers and their associates, but after the radiocarbon datings were available it seemed to us to be good scientific procedure to search for diagnostic artifacts in the gray sand itself.

Through a grant from an anonymous donor to the Museum of New Mexico, Wendorf returned to the Scharbauer site from October 24 to November 6, 1955, and conducted excavations in the gray sand. In November and December of the previous year, Sellards had made a search for cultural material in the white and gray sands, cutting several long transections of the blowout slopes by means of a ditch-digging machine and test trenches. While only flint chips, scrapers, burned bone, and caliche hearthstones were found in Sellard's explorations, he did find that there was a definite concentration of this cultural material inside the gray sand about 25 to 30 feet northeast of the skull location (Wendorf, Krieger, and Albritton 1955, Appendix 7, Fig. 35). Sellards' evidence was also sufficient to dispel any doubts of how the gray sand was deposited. It was a small dune and people were living on it or next to it during its accumulation.

Accordingly, Wendorf opened a series of 11 pits, each 8 feet square, immediately adjacent to Sellards' Pit 2 and parallel to Trench V (Fig. 1). The initial step in the excavation of each pit was the removal of the overlying thin mantle of red sand to expose the irregular and eroded surface of the gray sand. All excavations were made with a trowel; the surface was scraped until a pile of loose dirt had been accumulated and then, with a shovel, thrown on a ¼ inch screen. The material which failed to pass the screen was carefully examined, and all flakes and burned rocks which were not discovered in the initial troweling were saved and recorded as to approximate depth and location. Exact provenience data were recorded for all cultural objects found in place. The excavations in each pit were terminated when the basal white sand was exposed, which occurred at an average depth of 42 inches.

Flint flakes and burned rock were found in every pit excavated, and at depths ranging from 6 to 38 inches below the present surface of the gray sand, although they tended to be concentrated in a zone from 18 to 24 inches below the surface. Several pieces of burned bone were discovered also. All but one of these were unidentifiable fragments from very small animals, probably rodents. Morris Skinner of the Frick Laboratory, American Museum of Natural History, was able to identify one large burned fragment, which was found in Pit 8 at a depth of 18 inches, as the distal end of a right radius from a very small but mature extinct antelope, probably the four-horned *Capromeryx*.

In view of the significance of this identification, Skinner commented that because of "the very fragmentary nature of the specimen we must only suggest the generic allocation of *Capromeryx*. However, we can be quite certain that the specimen is not a modern pronghorn or cervid as the size of equivalent parts of these two animals shows that they are larger by about 30 to 40 percent." (Letter dated December 9, 1955.)

One hundred and two fragments of unburned bone were also recovered and, like the burned bone, they were mostly from small mammals and rodents. Only a small fraction of these were complete enough for identification. Claude W.

Hibbard of the Museum of Paleontology, University of Michigan, found the following individuals represented: four jack rabbits (*Lepus californicus* Gray), four cotton-tail rabbits (*Sylvilagus audubonii* cf *neomexicanus* Nelson), three pack rats (*Neotoma micropus* cf *canescans* Allen), two fragments of horse teeth (*Equus* sp.), a fragment of a mud turtle carapace (*Kinosternon* sp.), and two snails (*Helisoma anceps* and *Succinea*). A specimen of horned toad (*Phrynosoma cornutum*) was identified by Max Hecht of the American Museum of Natural History. Some of these small fossils, like some of those recovered in previous excavations in the gray sand, possibly were originally in the white sand and were moved by wind action into the

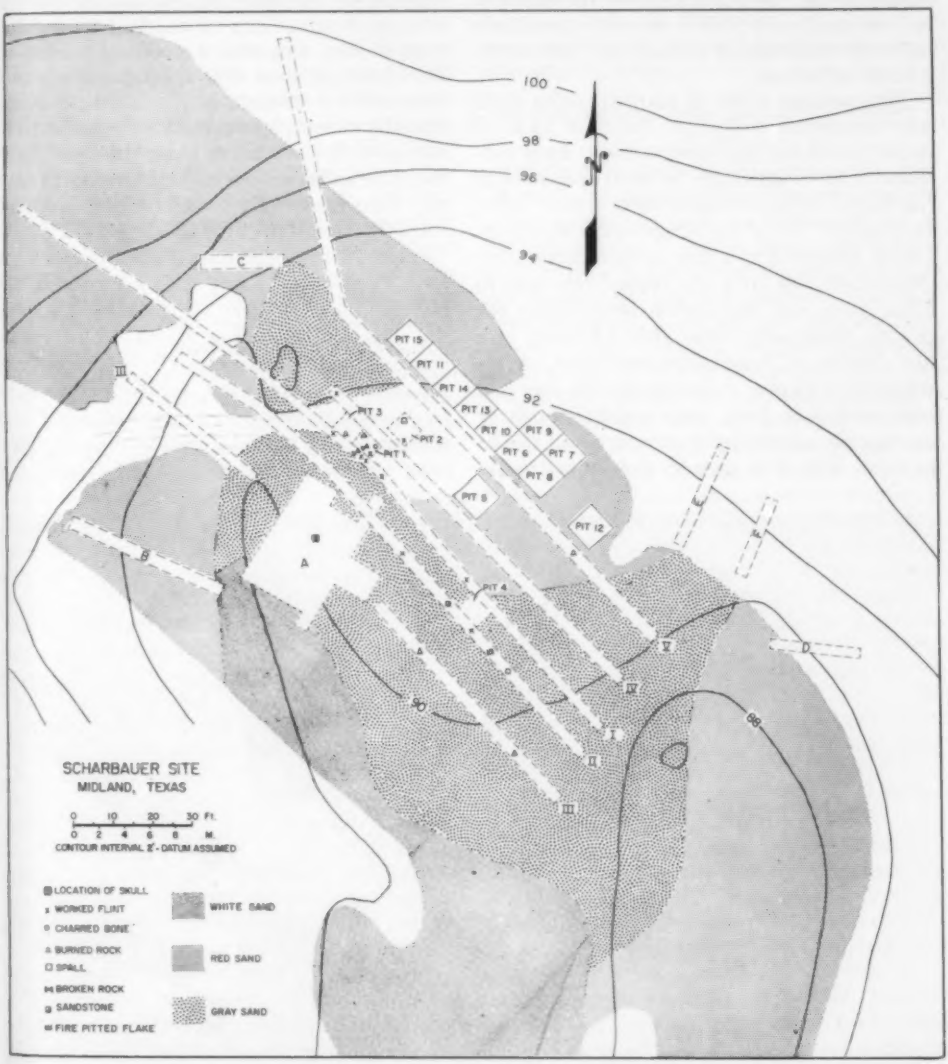

FIG. 1. Map of Locality 1, Scharbauer site, near Midland, Texas. Patterned areas show location of excavations by Wendorf in 1954 and 1955 and by Sellards in 1954.

gray sand as it accumulated. Unfortunately, it is difficult to tell which bones had been moved, if any. The only way to be sure that a group of bones was in primary association was to find them articulated, but since this was the scene of a camp many of them probably were discarded food remains, few of which would have been left properly jointed. Significantly, however, none were moved far enough to be polished by sand scouring. Of our finds, only the jack rabbit, cottontail, and possibly the pack rat remains occurred articulated or as clusters of bones from a single individual.

Two concentrations of burned caliche rocks were uncovered in Pit 8, at depths of 15 to 30 inches below the gray sand surface. Each consisted of an irregular pile of small chunks from less than 2 inches to slightly more than 6 inches in diameter. All of the burned rocks were completely encrusted by a thin calcium deposit, but underneath this crust the stones were gray to black from soot and carbon absorbed by the caliche, presumably while they had been in a fire. Neither of these burned-rock piles was arranged in a regular shape; apparently they had been cast aside from some nearby hearth or roasting pit, which unfortunately could not be located. The area around the burned rocks showed no evidence of burning and no charcoal was found.

Three definite tools were found in the gray sand. Two of these are "scrapers," the third a basal fragment of an unfluted, lanceolate-shaped projectile point. The two scrapers (Fig. 2 *a*, *b*) were discovered in place in Pits 6 and 11, at depths of 15 and 38 inches, respectively. These two specimens were examined by Hallam L. Movius, Jr., who described the smaller example as a small blade from which the butt end had been broken, removing the bulb of percussion. He observed that this specimen had been secondarily worked around its entire periphery, partially extending onto the lower (bulbar) surface as well, particularly along the left edge of the piece and across the rather blunt end. It had also been extensively used, resulting in an extremely irregular chipped edge. The larger "scraper" Movius identifies as having been made on a "side-blow" flake, so-called because the bulb is located midway along the right edge of the object rather than at the end. The striking platform had been carefully prepared prior to the removal of this flake, and both edges adjacent to one of the pointed extremities had been worked by fine secondary retouching. In European terminology, Movius would classify this

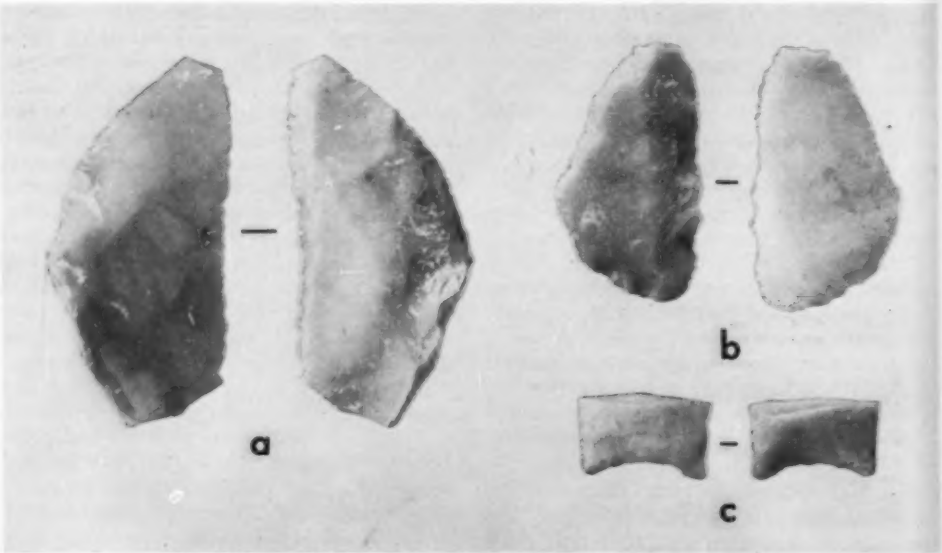

Fig. 2. Artifacts from the 1955 excavations at the Scharbauer site. *a*, *b*, scrapers; *c*, basal fragment of unfluted projectile point.

specimen as a "point," from which the tip has been broken off, although he notes that it is unusual to find a point made on a side-blow flake, which normally results from the trimming of a nucleus. Trimming flakes of this kind are very seldom as carefully retouched as in this case.

The projectile point fragment (Fig. 2 *c*) was discovered while screening the gray sand from the thin partition which had been left standing between Pits 10 and 13. The particular lump of sand in which it occurred was from the north half of the partition, between 10 and 16 inches below the contact of the red and gray sands. When found, the point fragment, like the scrapers and most other objects found in the gray sand, was covered with a thin lime film. It is slightly thicker (0.17 inches) than most other points of similar style from this site, although well within their range, and is carefully worked, thinned at the base on one side, and ground along the edges but not in the basal concavity. Its possible type affiliations are discussed below.

All of the burned bones except the *Capromeryx* were submitted to Wallace Broecker of Lamont Geological Observatory for radiocarbon analysis. Initially this sample seemed sufficient, but these specimens proved to be highly mineralized and they failed to yield the needed minimum of carbon.

Our attention next turned to the carbon-impregnated hearth stones found in Pit 8. We had learned that when a small piece of this burned caliche is placed in hydrochloric acid the carbonates are dissolved, leaving a considerable residue of black organic carbon. In this case the carbon residue had a fresh, almost oily cast, suggesting the possibility that crude petroleum had been used in the fire when the caliche had been burned. But while the Midland area is in the heart of a major oil field, the nearest oil producing deposit is several thousand feet below the surface, and there are no known natural "oil seeps" in this area. We concluded, therefore, that the oily appearance of the carbon residue probably was due to the fat which dripped from cooking meat onto the highly absorbent caliche. Several pounds of this burned caliche (sample L–347) were processed by Lamont. The resulting radiocarbon date is 20,400±900 B.P.

The radiocarbon content of the caliche residue was also measured, and it was found to have a radioactivity similar to a specimen 23,800 years old. The significance of this determination is not clear, however, because little is known about the initial radiocarbon content of modern caliche, although it is probably considerably less than currently growing wood. The main conclusion we may draw is that since the result is greater than the 20,400 date obtained from the carbon residue, there is less possibility that crude petroleum was present in the burned caliche.

Lamont Laboratory also determined a date of 13,400±1200 (sample No. L–304C) from pond snail shells found in the white sand and submitted by Sellards. Obviously, one or both of these two dates is incorrect for they are not in stratigraphic order.

URANIUM-RADIOCARBON DAUGHTER-PRODUCT DATING

Late in 1955 a new and highly interesting approach to the dating of fossil bone was brought to our attention by D. Hoye Eargle of the U. S. Geological Survey in Austin, Texas. Eargle asked us to provide a few slivers of fossil bone from the Midland site which he wished to submit to John N. Rosholt, Jr. of the U. S. Geological Survey in Denver, Colorado, for possible dating by modern methods of uranium analysis. Although the "uranium clock" has long been used to date rocks of great geological age, and in the study of deep sea sediments, it had never before been applied to relatively recent geological formations, nor, needless to say, to a situation remotely approaching any possible connection with man.

The "uranium and daughter-product method," as it is now widely termed, is based upon the principle that, as uranium decays, it forms "daughter products" at known rates. Thus, the proportional occurrences of such daughter products as protactinium (Pa^{231}), thorium (Th^{230}), and radium (Ra^{226}), with uranium provide a means of calculating the time at which an organic sample had absorbed uranium. The age of a bone fragment, for example, which has absorbed uranium from the surrounding ground may be determined if (1) the uranium was introduced during a comparatively short time in the very early history of the specimen; (2) the daughter products were not carried into the sample along with the uranium as a later contamination; and (3) there was no later leaching out of either the uranium or the daughter products from the sample. Such an ideal situation probably occurs only very rarely in geological situations (or archaeological situations which involve bone of some antiquity). Nevertheless, in view of the divergent results of

radiocarbon datings at the Midland site, and Eargle's urgings that the method at least be tried, we supplied him with a few grams of fossil bone (sample 229122). Subsequently an additional piece of fragmentary bone from the gray sand (sample 249088) and a small section from the human skull (sample 253502) were submitted for analysis. The results are given in Table 1.

Considering that this was merely an experiment, and that Rosholt was given no clue whatsoever as to the probable or expected age magnitude, these results may be regarded as phenomenal in that they all fall rather close to the maximum age obtained from radiocarbon dates on burned caliche from the gray sand; that is, roughly 20,000±2000 years.

It might easily have been concluded from these results that uranium isotope dating, where the physical conditions are right, is as accurate as radiocarbon dating and perhaps even more so. However, we resolved to try it in other sites. A series of samples was submitted to Rosholt from the Blackwater Draw ("Clovis") site in eastern New Mexico, where a clear physical stratigraphy accompanies definite faunal and cultural changes. Here the results were about as expected in the basal stratum of gray sand (average age of three isotopes, 18,000 years) but nonconcordant in other strata, giving ages far too great. In these cases, leaching of uranium from the fossil bone may be suspected.

A sample of burned camel bone provided by Ruth D. Simpson from the Tule Springs site in southern Nevada, which had previously been dated by radiocarbon analysis at greater than 23,800 years, proved not to contain enough uranium compared to the daughter products present for age calculations; again, leaching of uranium may be suspected.

In summary, despite some remarkable results at the Midland site, the value of isotope dating in situations of low age magnitude (for example, the late Pleistocene) remains as yet unproved. It should, however, be subjected to more such tests in a variety of field situations and be compared, where possible, with the extreme ranges of radiocarbon dating. A detailed discussion of this method and the results on materials from several archaeological sites will appear shortly in a paper by Rosholt (in press).

Discussion

The discoveries made in the 1955 excavations at the Scharbauer site somewhat clarify the question of what cultural and faunal material can be associated with the fossil human remains

Table 1. Uranium and Daughter-Product Dating of Three Midland Specimens.

Nuclide	*Isotopic Content**	*Isotope/Uranium Ratio*	*Isotope Age (Years)*
Sample 229122			
$U^{238}+U^{235}$	0.013		20,000
Pa^{231}	0.0043	0.33	20,000
Th^{230}	0.0023	0.18	23,000
Ra^{226}	0.0013	0.10	15,000
		Average	18,000
Sample 249088			
$U^{238}+U^{235}$	0.0063		
Pa^{231}	0.0018	0.29	17,000
Th^{230}	0.00081	0.13	16,000
Ra^{226}	0.00073	0.12	17,000
		Average	17,000
Sample 253502			
$U^{238}+U^{235}$	0.0014		
Pa^{231}	0.0006	0.36	22,000
Th^{230}	0.00022	0.16	20,000
Ra^{226}	0.00016	0.11	17,000
		Average	20,000

* $U^{238}+U^{235}$ content is given in percent; U^{238} content is assumed in normal abundance with U^{238} and for these calculations a constant value is used for U^{235} which is proportional to the total uranium content. The content of Pa^{231}, Th^{230} and Ra^{226} are given in percent equivalent, a unit which indicates that amount of parent uranium isotope which would be required to support the amount of daughter isotope actually present if equilibrium were to exist between daughter and parent. Thus the isotope/uranium ratio is the fraction of the equilibrium obtained.

previously reported. The small horned ruminant, *Capromeryx*, provides an especially interesting problem, for it has generally been regarded as a rare Pleistocene animal of comparatively limited geographical range. It has been reported from late Wisconsin deposits in California (Schultz 1938); but before its appearance in the Scharbauer site, as reported in *The Midland Discovery*, it was believed to have become extinct long before most other late Pleistocene animals. The *Capromeryx* should not be confused with the related, but quite distinct *Tetrameryx*, a four-horned antelope which occurred as an important element of the fauna in Burnet Cave, New Mexico, where it was associated with human artifacts, including a Clovis fluted point.

Previous to the 1955 excavations, we had reported 15 occurrences of *Capromeryx* in the white sand deposit. It was, in fact, the second most common fossil identified in the collection, closely following horses. *Capromeryx* also occurred in the red sand (two instances), hence it was not surprising to find a specimen in the gray sand in 1955. The latter specimen, however, was the only one which had been burned. It is perhaps possible that it was secondarily derived from the white sand and accidentally burned during the gray-sand occupation. It is also conceivable that the very fragmentary *Capromeryx* fossils in the red sand were carried into it by wind action, but on the other hand, a horse jaw with four teeth in it was found in the red sand and could hardly have been moved by wind. The question cannot be answered conclusively then, whether *Capromeryx* survived in the area during the gray and red sand accumulations, but this seems quite possible.

The most frequent fossil remains from the Scharbauer site are those of at least two species of horse, *Equus* sp. and *Asinus conversidens*. These occurred in the white, gray, and red sands, as reported in *The Midland Discovery*. The 1955 excavations revealed only two unburned horse teeth from the gray sand, and although these might have been moved into the gray sand by wind action, actual survival of horses into the succeeding red sand accumulation is practically certain because of the jaw with four teeth mentioned above.

The relative time of extinction of horses in the Southern High Plains can be fairly well estimated from controlled excavations in two stratified sites and several other localities. The faunal sequence at Blackwater Draw No. 1 ("Clovis site"), less than 200 miles northwest of Midland, has been summarized by Sellards (1952: 28–31) and Evans (1950, 1951). The faunal sequences at Lubbock Lake site, approximately 100 miles north of Midland, has been summarized by Sellards (1952: 52–8). In both cases, many of the detailed data remain unpublished.

The field data at Blackwater Draw and Lubbock Lake make it clear that, in an equivalent basal stratum at both sites, mammoth and horse fossils are abundant, the latter representing four or five species. Camel and a few bison remains also occur in this stratum. Overlying it at both sites is a diatomaceous clay with abundant remains of extinct bison and several still-living species of small animals, but not, as yet, a single identifiable fossil of mammoth, horse, or camel. The extinct bison persists into still higher strata at both sites which also do not reveal mammoth, horse, or camel. The complete disappearance of these animals, before the diatomaceous lake deposits in question began to form, is therefore very strongly indicated, providing an important reference point for understanding the faunal sequence at the Scharbauer site. The present environment at all three localities is almost identical, and there is no reason to think that it was any less similar during past climatic fluctuations. In view of this, it is surprising that *Capromeryx* has not been identified at either Blackwater Draw or Lubbock Lake. This suggests that its occurrence at the Scharbauer site has chronological significance in the Southern High Plains.

The diatomaceous clay stratum under discussion not only marks an abrupt change in late Pleistocene fauna, but it is accompanied by cultural change at Blackwater Draw and has two radiocarbon dates at Lubbock Lake. Whether or not these dates are completely acceptable (see below), this combination provides our best reference point for the correlation of geological, climatic, faunal, and cultural events in the Southern High Plains. From it, the relative age of archaeological material can be estimated both backward and forward.

As is well known, the diatomaceous stratum at Lubbock Lake has yielded several projectile points of the "classic" Folsom fluted type in association with burned bison remains. These remains, near the base of this 4-foot stratum, gave a radiocarbon age determination of 9883±350 years in 1950 (Sellards 1952: 55). Subsequently, in 1955 a second determination of 9700±450 years (sample L–283G) was made on pond snail

shells about at the midpoint of the same stratum (Broecker and Kulp 1957). The second date does not apply to Folsom artifacts but gives a rough indication of the age and rate of accumulation of the diatomite. The equivalent diatomite at Blackwater Draw is thinner (its top had been eroded), but it can be assumed that the many Folsom points recovered from it and the associated bison are about the same age as those at Lubbock.

Underneath the diatomite, the "gray sand" stratum with horses, mammoth, camel, and bison has not been dated at either site. At Lubbock, only a worked flint flake has been found in it, whereas at Blackwater Draw it contained an assemblage of stone, bone, and ivory artifacts termed the Llano complex by Sellards (1952: 17–42). The most important of these for purposes of correlation are projectile points of the Clovis fluted type. While the significance of this type was obscured for many years because of confusion with "classic" Folsom (such specimens being called "Folsom" also, or "Folsom-like," "Folsomoid," "generalized Folsom," etc.) it is now general practice to distinguish them for several reasons: (1) Clovis points are, on the whole, considerably larger, heavier, and more crudely chipped than Folsom; (2) Clovis flutes extend only part way from the base to the tip, in contrast to the full-length flutes of Folsom; (3) Clovis points have concave bases which recurve toward rounded corners, while Folsom bases are deeply concave with sharp, needle-like corners and often have a small protrusion in the middle of the base; (4) Clovis points have been found in association with mammoth in several localities from the central Great Plains to the Arizona-Sonora border while Folsom points have so far been found in positive association only with extinct bison; (5) the distribution of Clovis points is far greater than that of Folsom, the former extending across the United States and into Alaska and Mexico whereas the latter are essentially limited to the Great Plains and adjacent regions; and (6) where there is good stratigraphic control, Clovis points either underlie Folsom or one usually occurs to the exclusion of the other.

This is not to say that distinction of the two types is always easy. They represent a continuous tradition with the older and more widespread Clovis techniques reaching a climax of fine workmanship in the Folsom type in the central parts of the continent. Also, while generally large, heavy, and rather crudely made, Clovis points reveal great variation in size, even when found in a single association, as with the mammoths at the Naco and Lehner sites in southern Arizona (Haury 1953, 1956 [See also article this issue. — Editor.]). We may note, too, the very small, thin, and partially fluted point from the gray sand at Blackwater Draw illustrated by Sellards (1952: 34, Fig. 16 *b*). Furthermore, as in the case of Folsom, Clovis points may sometimes be fluted on only one side, and may occasionally be accompanied by specimens of the same shape and proportions but not fluted on either side. In such cases, "unfluted Clovis points" may be difficult or impossible to distinguish from Plainview points (which belong to a later, early postglacial horizon) unless something is known of their geological and cultural association. Both may also be confused occasionally with "unfluted Folsom points" (now tentatively called Midland points) except that the latter are, on the whole, notably smaller, thinner, and more finely flaked than either "unfluted Clovis" or Plainview points; and their bases are similar to those on Folsom points.

Needless to say, none of these types has yet been adequately defined as to range of size and workmanship, nor can they be until their comparative distributions in time and space and their associations receive much more study. This in turn depends upon vastly more field work under controlled conditions than has yet been conducted anywhere in these horizons.

Referring now to the fragmentary projectile point found in the gray sand at the Scharbauer site in 1955 (Fig. 2 *c*), we find it difficult to assign it with confidence to any particular type. After correspondence with Wendorf, Wormington (1957: 244) referred to this specimen as "a basal fragment of a Midland point" with the assumption that it would make the gray sand of Folsom rather than pre-Folsom age. We now feel that preliminary "identification" should be qualified. Although this point is small, it would not be outside what we consider to be the size range of either Plainview or "unfluted Clovis" points, and its recurved base with rounded corners could agree with either of these.

If, then, the present specimen were a small Clovis-like but unfluted point, it would strengthen our previous suggested correlation of the Scharbauer white sand with the gray sand at Blackwater Draw and Lubbock Lake. This would mean that the dry cycle represented by

the Scharbauer gray and red sands would conform to the erosional disconformity and the discontinuous brown-sand wedge which come between the gray sand and diatomite at Blackwater Draw (Sellards 1952, Fig. 11).

On the other hand, while the small size and thinness of the fragment may suggest a Midland point, the basal recurve is dissimilar to that of Midland (and Folsom) points. Furthermore, if this specimen were closely akin to Folsom points, its occurrence in the Scharbauer gray sand would be seriously out of gear with the faunal correlation discussed above. That is, if one argued that the projectile fragment is a better or more chronologically limited "index fossil" than any of the late Pleistocene vertebrates, one would have to correlate both the gray and the red sands at Scharbauer (reflecting a very dry climate) with the diatomite stratum at Blackwater Draw and Lubbock Lake (reflecting a cool and moist climate), then assume that the mammoth, horse and camel — and even the *Capromeryx* — lived a great deal longer at Scharbauer than at the other sites. There is a possibility, of course, that Folsom and Midland points were being made before the diatomite accumulation began to form, and before the elephant, horse, and camel became extinct in the Southern High Plains. There is no field evidence available, however, to support such an hypothesis and the common occurrence of *Capromeryx* at Scharbauer alone would remain especially difficult to account for.

A third alternative, that the fragment belongs to a small Plainview point, seems improbable because of the above-mentioned faunal situation and the virtual certainty that this type became well established only after the fluted-point tradition had ended. It is true that a radiocarbon date on the Plainview type site is only slightly later than the date on Folsom remains at Lubbock Lake (see below), but the Plainview type is known to have continued for several thousand years into later archaeological complexes which contain no fluted points.

Since the publication of *The Midland Discovery*, two more radiocarbon datings have been obtained for the Scharbauer site, bringing the total to four. A second date has been obtained for the diatomite at Lubbock Lake, one from Plainview, and three at Blackwater Draw. The six datings from the latter three sites, together with cultural, faunal, and stratigraphic evidence, provide some basis for evaluating the four Scharbauer dates, which cannot be harmoniously reconciled with one another or with the stratigraphy of all the sites taken together. To aid in their discussion, the ten dates have been divided into three groups (Fig. 3). We will not attempt to decide which group — if any — is "correct."

Into Group A we would place seven dates which form a logical sequence in that they are in stratigraphic order, not only physically but in their associated faunal and cultural remains as these are understood at present. First, there is a new determination of 13,400±1200 years (sample L–304C) on snail shells from the white sand at Scharbauer. This date, first reported by Krieger (1957: 322–3) as 12,500±1200 years, was later recalculated in the laboratory. One might say, at least for the sake of argument, that this dating is of sufficient magnitude to be agreeable with the presence at Scharbauer — and by extension to the gray sand at Blackwater Draw and Lubbock Lake—of mammoth, horse, camel, and perhaps other mammals which became extinct in the region before the next date available. The next one, then, would be the well known determination of 9883±350 years (sample C–558) on burned bison bone associated with Folsom artifacts at the base of the diatomite stratum at Lubbock Lake. Of only slightly less magnitude (if at all, considering the margin of error) are the datings of 9700±450 years (sample L–283G) on snail shells from higher up in the same diatomite at Lubbock Lake, and 9800 ±500 years (sample L–303) on snail shells associated with extinct bison and Plainview points at the Plainview site. This Plainview date, first reported by Krieger (1957: 322–3) as 9170±500 years, also was later recalculated in the laboratory. A second date of 7100±160 years from the Plainview type site was reported at the same time, made on "organic portions of fossil bison bone." Sellards had, however, warned that by the time this bone was collected, the site had been exposed for several years and plant rootlets quite likely had contaminated the sample to produce an age determination much too young.

The recalculated Plainview date comes so close to the Lubbock Folsom date that one wonders whether the latter is somewhat too low. Following these, the two dates of 6230±150 and 6300±150 years obtained by Sellards on partially burned and unburned bison bones, respectively, at Blackwater Draw in association with artifacts of Sellards' "Portales Complex" (Krieger 1957: 323) agree with the stratigraphic position of this complex above the diatomite

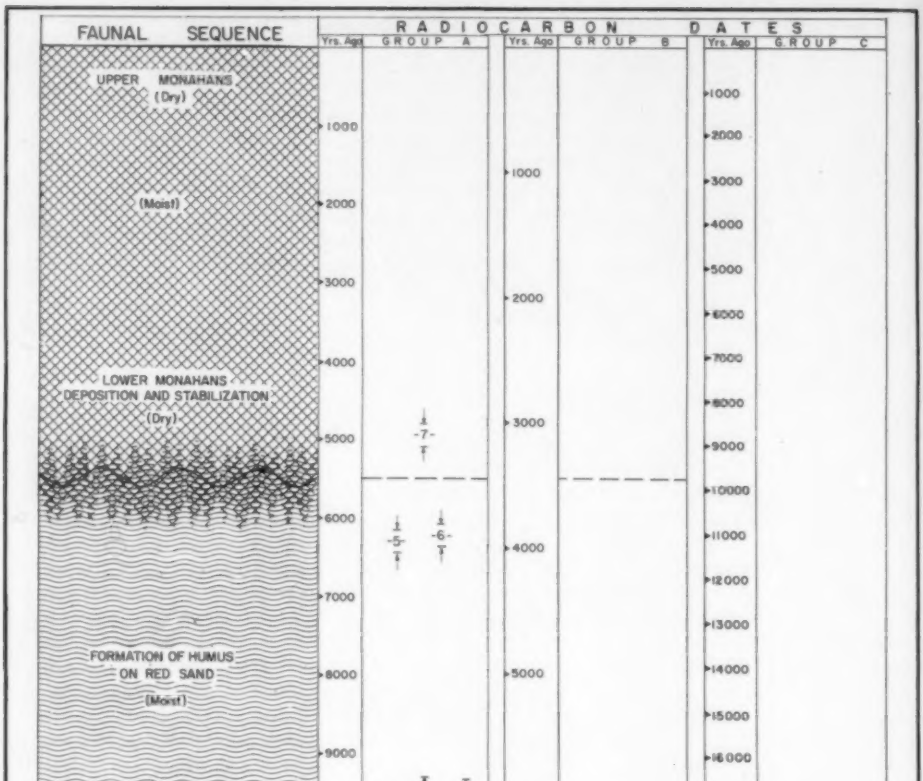

FIG. 3. Comparison of the faunal sequence of the Southern High Plains with three groups of radiocarbon dates. The various deposits at the Scharbauer site are correlated with the faunal sequence.

there. Lastly, Group A includes a date of 4950 ±150 years on burned bone associated with stemmed and notched "Archaic" points found in the upper "jointed sand" at Blackwater Draw (letter from Sellards dated December 26, 1956).

Group A, then, is in general accord with geological and faunal sequences as outlined in *The Midland Discovery*. If the dates are essentially correct, several conclusions can be drawn:

1. The arid interval at Scharbauer—the drying up of the stream or pond in which the white sand was deposited, the growth of the gray-sand dune, and the migration of red-sand dunes over both the white and the gray sands — may have lasted no more than a few hundred years rather than thousands.

2. This arid interval perhaps coincided with the Two-Creeks interstadial in the Great Lakes region, which has several radiocarbon datings falling between 11,000 and 12,000 years ago. For example, five University of Chicago determinations (samples C–308, C–365, C–366, C–536, and C–537) average 11,404±350 years; two determinations of the U. S. G. S. Washington laboratory (samples W–42 and W–83) average 11,370±100 years; one Yale University determination (sample Y–147X) gave an age of 11,940 ±390 years; and another Yale sample (Y–237) gave an age of 11,690±370 years. The two Yale samples were logs which evidently were carried by re-advancing ice and they may have been somewhat older than the ice which moved them.

3. The subsequent stabilization of the red sand — and the heavy vegetation on it which resulted in a deep humus zone — occurred during a comparatively long period of much moister conditions than the present, presumably in conjunction with the last Wisconsin stadials, Valders and Cochrane, which followed the Two-Creeks interstadial.

The implications of this tentative "correlation" would be that the red-sand migration, as far as the Scharbauer *locality* is concerned, was a rapid process under extremely dry *local* conditions with the sand not being moved any great distance, but already present in the vicinity because of some greater migration farther in the past, perhaps during the mid-Pleistocene. On the other hand, this chronology would call for sudden extinction of several species of large Pleistocene mammals; and it would reduce the life of Folsom artifacts to a comparatively short time, approximately from 11,000 to 10,000 years ago. The Lubbock Folsom date of 9883±350 years ago must, if taken at face value, mark the very end of Folsom times.

The two dates assigned to Group B are those already published by Wendorf, Krieger, and Albritton (1955: 9, 99–100), determined by the University of Michigan laboratory. Samples M–389, M–390, and M–391, mammoth tusk and two fossil bones from the top of the white sand, gave an age of 8670±600 years when combined into one sample. Sample M–411, consisting of fossil bone fragments from the gray sand, gave an indicated age of between 4000 and 5000 years after a standard 48-hour run, which was increased to 7100±1000 years when counted for two additional weeks. While these two determinations are in stratigraphic order, we listed a number of reasons for believing them to be too low. Not only was the amount of radioactive carbon inadequate in both cases, but if these dates were even approximately correct, the arid period of gray and red sand accumulation would be of post-Pleistocene age, presumably the Altithermal as defined by Antevs. Further, the *Capromeryx*, horse, camel, and mammoth associations with the gray and red sands would require that the diatomite stratum at Blackwater Draw and Lubbock Lake be of post-Altithermal age. Few, if any, geologists or archaeologists would take such a "correlation" seriously, hence we regard Group B as the least probable.

Group C consists of a single date, 20,400±900 years, obtained on burned caliche from the gray sand as mentioned above. If correct, this date would place the arid interval of gray and red sand deposition well back into the Wisconsin stage, perhaps into the Bradyan interval, for which there are radiocarbon dates ranging from about 14,000 years to somewhat more than 20,000 years. The actual ages of Wisconsin phenomena are becoming better known through radiocarbon dating, but are still the subject of much controversy among glacial geologists themselves. We feel, therefore, that we would be foolish to do more than suggest that this Scharbauer date might eventually be reconciled with one of the Wisconsin interstadials prior to Two Creeks. While it would give considerably more antiquity to the projectile point fragment than the 12,000 to 15,000 years commonly "allowed" for the Clovis type (not to mention the 10,000 years or so for Folsom points), it would give considerably more freedom in the gradual extinction of many late Pleistocene mammals, both in comparison with Blackwater Draw and Lubbock

Lake and in the puzzling occurrences of *Capromeryx* at Scharbauer.

In this connection it may be speculated that the Folsom date of 9883±350 years at Lubbock Lake is too young. Not only does this date come very close to the Plainview date cited above, but the burned bison bone on which it was obtained lay under water for some thousands of years and may well have become contaminated by organic life until it became deeply buried in later sediments. There are now so many datings on so-called "Early Archaic" remains in various parts of the United States which extend to times greater than 9000 years, that the one Folsom date may be doubly suspect. Needless to say, these matters are not easily solved with our present information.

At any rate, an age of 13,400±1200 years for the white sand at Scharbauer, and 20,400±900 years for the gray sand cannot be reconciled for they are in reverse of the stratigraphic order. Either or both may be erroneous. Age determinations on carbon extracted from burned caliche bring up certain chemical problems which need to be clarified by further work along these lines.

Summary

Excavations at the Scharbauer site in 1955 have thrown some new light on the antiquity of the fossil human remains previously reported. These excavations and the new radiocarbon datings here and elsewhere have not, however, provided sufficient data for a conclusive statement on the age of the human being, or on the faunal and cultural material in the principal formations. In general, the major conclusions offered in *The Midland Discovery* remain unchallenged. The radiocarbon dates here and at related sites in the Llano Estacado farther north taken together, provide three conflicting geological and faunal correlations. One of these interpretations (our Group A) is perhaps somewhat more plausible than the others; but Group C should not be entirely discounted even though it may be too high by an unknown quantity; Group B remains the least plausible interpretation in the light of all present information regarding the sequence of events in the late Pleistocene of the Southern High Plains.

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NOTES ON THE ARCHAIC OF THE APPALACHIAN REGION

JOHN WITTHOFT

ABSTRACT

The long stratigraphic sequence of separate archaeological horizons at the mouth of the gorge of the Pee Dee River in North Carolina necessitates changing earlier reconstructions of Piedmont archaeology. The stratigraphically documented series of projectile points from this site makes it possible to separate in time the varied forms of points originally assigned to the Baden and Guilford foci. Moreover, this evidence contradicts the typological arrangements of points in terms of logical evolutionary development and suggests that Archaic sequences in other parts of the Appalachian region may have to be radically changed when stratigraphic data become available. Stratigraphy at the Duncan's Island site in Pennsylvania, though less precise than that at the Pee Dee site, indicates that the local typological reconstructions for parts of Pennsylvania are in need of revision. Basal levels at Duncan's Island produce quartzite tools of types scattered throughout central Pennsylvania and often considered to represent an extremely early Archaic industry. The concentration of quartzite tools at the DeTurk site, though not dated stratigraphically, provides typological justification for the idea that the quartzite industry may be a survival of an earlier forest-based proto-Archaic tradition.

THE GREATEST need of eastern archaeology is more stratigraphic work. There are many sites from which we have some information on superposition of artifact types, and which indicate broad trends in Archaic history. At the Lamoka Lake site in New York, one culture complex can be isolated and general trends in the later sequence are indicated. However, the problems of chronological subdivision in New York are so difficult that data from many more sites are needed. Site situations involving superposition rather than actual stratigraphy are adequate only to outline trends throughout a major sequence, rather than to define actual steps and stages. Sites with deep and highly differentiated stratigraphy are as yet almost unknown, but they are of such basic importance that locating and studying them should take precedence over any other approach to the Archaic.

THE PEE DEE ARCHAIC OF NORTH CAROLINA

The only known stratigraphic column showing extreme sensitivity to time within the Archaic is on the Pee Dee River in North Carolina. It has revolutionized our thinking about the archaeology of the southeast. It is made up of stages which had been included within a single complex at the close of the Archaic, the Badin focus (Coe 1952: 306–7). Badin had been postulated on evidence from more than 100 shallow sites, representing an almost perfectly recurrent complex. This complex was parallel to Ritchie's Laurentian and to the complex of the Green River shellheaps of Kentucky. It looked like a typologically diffuse and internally variable manifestation of a generalized late Archaic. The Guilford focus at first appeared to be a part of this complex, but its projectile points were not at home with the other lithic material. These points are long, lanceolate, delicately flaked, thick, with a somewhat diamond-shaped cross section and central ridge (Fig. 1 *hh*). They have a very narrow concave base and they either lack stem constriction or narrow to a straight-edged tang which is slightly to heavily smoothed along the edges. Their resemblances to western types of late paleo-Indian or Early Plains Archaic tradition are striking. Later, Coe found three sites at which the Guilford material occurred alone, and he interpreted the Guilford material as a chronologically early stage in the local Archaic showing strong affinities to paleo-Indian (Coe 1952: 304).

In 1950, Coe began excavation on a terrace at the mouth of the gorge of the Pee Dee River, and has since been gradually dissecting a deep stratified site which completely invalidates all of our earlier ideas. Only the briefest notice of this site has appeared in print (Coe 1951), and I am much indebted to Coe for access to his specimens, notes, and ideas on this site. The soil sequence at the site is very complex and I am unable to interpret it in terms of the mechanics of alluviation or the geological history of the Pee Dee River. More than eight separate archaeological horizons are enclosed in discrete soil horizons, some of them representing flood levels, some representing soils formed by weathering on long stable surfaces, and others representing slow and orderly sedimentation. The top foot of the site includes all of the post-Archaic material of the area, with many pottery types represented. The lowest 2 feet of the excavation consist of rapidly deposited, water-laid sand. The projectile points from this level have been

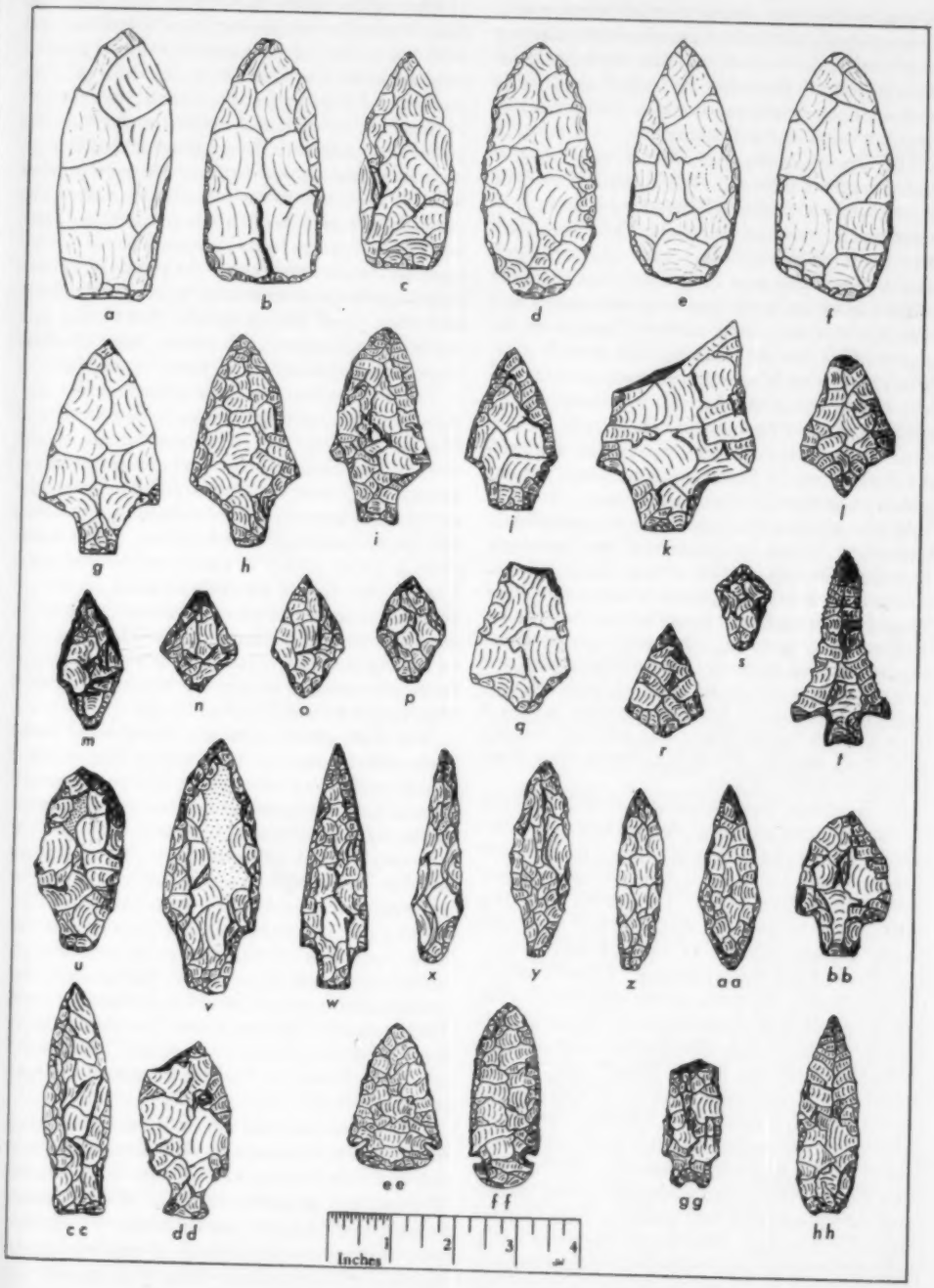
transported by water, and are small diamond-shaped points (Fig. 1 *r, s*). These are of a form which is found throughout the United States and includes the Lake Mohave type of California. The level above this represents soil developed on a stable surface. The projectile points of this zone are corner-notched, barbed, serrate-edged tools of large size (Fig. 1 *t*). This is the projectile point type that we considered to bridge an Archaic-Woodland transition within Badin. However, in the stratigraphic column it is one of the earliest forms, and cannot be given a date within any late Archaic series. The next level above this produces bifurcated-based points (Fig. 1 *gg*). Above, a succession of discrete soil zones includes six additional cultural horizons. Each bears a single typologically distinct and crisply distinguishable form of projectile point; all are forms previously included in the Badin focus. There is no developmental pattern in the succession; each type seems entirely unrelated to those above and below it. The actual sequence condemns all of my prior ideas about an orderly evolutionary development of forms of Archaic projectile points. For example, the Guilford level in this site is above the center of the column, higher than a level with small stemmed projectile points and bannerstone fragments. Regardless of the typological resemblances, the Guilford point can scarcely be related to paleo-Indian lithic traditions. The highest nonceramic level contains projectile points of the Savannah River type, as might be expected from the association of this type with fiber-tempered pottery elsewhere (Fairbanks 1942).

The stratigraphic column shows many peculiarities, and we expect that still others will be apparent as more of the site is excavated and studied. Bannerstone fragments are not associated with most of the horizons, but have been found in only one level and associated with simple, stemmed projectile points. So far there have been no exceptions to the correlation of separate soil horizons to single projectile point types. One cannot derive any of these projectile point types from the type of the level immediately below by any but an unlikely series of intermediary forms. The total series of points from the site can be laid out in a very logical evolutionary sequence, but the distribution of the specimens within the site contradicts any such interpretation. This is very disturbing, for I think that I can see such developmental trends and evolutionary sequences in the types of nearby areas. I now believe that all of our local sequences within the Archaic, and all of our postulated complexes and foci, must be considered suspect until they have been checked against local stratigraphic columns that are as sensitive as this particular example. The main consequence of this site is that the Archaic sequence for the Piedmont and central Appalachians is now chaos, and practically every one of our earlier ideas has been demolished. I hesitate to extend the same attitude to other areas, but the implications of this site to general Archaic culture history are tremendous.

The Duncan's Island Site

The site on Duncan's Island, Lancaster County, Pennsylvania is important to knowledge of the local Archaic, even though data from this flooded site are not precise. The site, formerly the highest part of the island, was once about 20 feet above river level. Now surrounded by water impounded by a power dam, it is only a couple of feet above normal water level, and is mantled by 3 to 6 feet of culm. Most of the collections come from eroded parts of the site, and excavations have been carried on under dif-

Fig. 1. Archaic tools from Pennsylvania and North Carolina. *a–f*, lanceolate spearpoints from the DeTurk site, Neversink Station, Berks County, Pennsylvania; *g–l*, corner-removed spearpoints from the Long site, Lebanon County, Pennsylvania; *m–q*, diamond-shaped points from deeper levels of the Duncan's Island site, Lancaster County, Pennsylvania; *r, s*, diamond-shaped points from Mount Gilead, North Carolina (these and other North Carolina specimens illustrated do not come from Coe's stratified site, but represent the same types at a nearby site); *t*, Badin serrate spearpoint from Mount Gilead, the form found in the next to the bottom level of Coe's stratified site; *u–dd*, stemmed and lanceolate spearpoints from middle levels at Duncan's Island; *ee, ff*, knives with smoothed basal edges representing two of the many shapes of these notched knives in their original form prior to the drastic beveling and change in blade form by resharpening that characterizes most specimens, Lancaster County, Pennsylvania; *gg*, notched-base point from Mount Gilead, the type found in the third level from the bottom of Coe's stratified site; *hh*, Guilford point from Mount Gilead. Material: *a–l, q*, Hardiston quartzite; *m–p*, aporhyolite, one of the metamorphosed rhyolites from south central Pennsylvania; *r–t, gg, hh*, exceedingly fine-grained quartzite, highly metamorphosed, almost glassy except for abundant inclusions of mica flakes — poorly known metamorphics from the fall-line outcrops at the mouth of the Yadkin gorge in North Carolina; *u–dd*, chipped from river pebbles of rather nondescript sandstones, mainly nonmetamorphic quartzites and siltstones of medium-fine grain which may have originated in the Pennsylvania sandstones of the northern Pennsylvania Carboniferous.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ficulty, with lower levels always below water. Consequently, our documented sample may not be entirely reliable. Most of the work has been done by John deBarbidillo of York, Pennsylvania with my occasional participation. I draw heavily upon his notes and collections.

The upper levels, including a plowed zone and the upper part of a lightly leached A zone of sandy loam, produce Laurentian-like tools in a variety of types and materials. The plowed soil also contains pottery and later objects of all stages. Since this part of the site is at the peak of the island, its height has been reduced by erosion while it was used as farm land, and the plowed zone has cut deep into the gray A zone. The top of the B zone is generally less than 2 feet below the plowed zone, is reddened and well compacted by clay and iron salts, and is almost consolidated in its lower levels. Beneath the 3 to 4 feet of B zone, the profile is a light yellow, uncompacted sandy alluvium.

Within the B zone and in the soil immediately beneath it, there are scattered but relatively abundant broken stones, chips, artifacts, and other camp debris. Lenses of broken and highly burned stone represent hearths and the sparsity of charcoal suggests that they were long exposed on the ground surface. The artifacts contrast very strongly with those of the upper level, and pertain to a poorly known complex which I have termed Poplar Island and which is known only from sites on the Susquehanna river edge (Witthoft 1947: 123–4).

In the yellow sand below this artifact horizon we have found no camp debris, but only scattered artifacts of a variety of types. These appear to have been lost on old land surfaces rather than dropped in a camp. They differ from the tools of higher levels in the site, and represent poorly known cultures of upland regions east and west of the Susquehanna. These artifacts pertain to time intervals earlier than the Poplar Island complex, and represent the material culture of several contiguous culture areas. They perhaps overlap the Poplar Island complex but there is some thickness of soil separating the two horizons at Duncan's Island. Artifacts from the deep levels are made from nonflinty stones not found in the immediate vicinity. A predominant form is the lozenge-shaped point, flaked from the aporhyolite that outcrops near Gettysburg (Fig. 1 *m–q*). This projectile point has a wide distribution, with its greatest concentration in this material on the highlands west of the Susquehanna and on the Potomac.

The other major aporhyolite tool from the deep levels is a very slender but thick, long point with just a trace of stem constriction. Its greatest concentration elsewhere is on the hills of York county, and it is restricted to a small region south of the Juniata River, and east of the rhyolite outcrops. In contrast to the geographic distribution of the diamond-shaped point, this type is quite local. These two types are usually among the most deeply weathered tools made from aporhyolite. Our series from Duncan's Island is typologically instructive because the points have been protected from weathering by the soil matrix, and they show flaking details that would normally be obliterated. However, most of them show slight abrasion from water transport.

The third series from the deeper levels consists of large corner-removed spearpoints of Hardiston quartzite, which outcrops on the ridges of South Mountain some ten miles east of this site. A few of the Duncan's Island examples are of other material. Rare extremes of this type are large diamond-shaped points. They represent a local complex centered in Lebanon County but found throughout most of eastern Pennsylvania, and they are practically identical with the Savannah River point. The Long Site in Lebanon County, studied only through surface collections, is an almost unmixed site with this type of spearpoint (Fig. 1 *g–l*).

The final series from the lower level is the most difficult one to interpret, as it consists of deeply rotted tools of argillite. The predominant type is a small tapered-stem form which intergrades into a diamond-shaped point. A minority consists of longer spearpoints with tapered stems like the Pinto Basin type. The gritty argillite for these points probably came from Maryland. Argillite tools and flakes are concentrated in the lowest portions of the Poplar Island horizon. A little chippage occurs in this higher level, but only finished tools are found in the bottom level. The available specimens are too damaged by weathering for typological study. They represent types found everywhere in eastern Pennsylvania and neighboring regions.

The usual hallmark of a Poplar Island site is the presence of quantities of broken river stone, chips of cobblestone, and rejects. The majority of tools, and probably all those of local manufacture, were flaked from boulders. The preference of these people for kinds of rock was indeed peculiar. They ignored flints and quartz, and based their stone technology almost entirely on

granular stones, rhyolite, silicified sands, cobblestone quartzite, and pebbles of other aphanitic igneous and metamorphic rocks. They used the three available lavas; Canadian rhyolite from river pebbles, diabase from nearby Triassic dikes, and basalt from southeastern Pennsylvania. They even chipped spearpoints from local gneiss and schist. Despite their unusual choices of material, their workmanship was expert. Poplar Island types are not found on local Archaic sites back from the river. They are practically restricted to sites on the islands and the river shore, throughout the lower Susquehanna and along the shores of Chesapeake Bay.

The Poplar Island spearpoints show the following traits: long, slender, thick proportions; very acute and sharp tips; base tapered or stemmed; smooth contours formed by broad, flat chip scars; edges shaped by many tiny flakes; tang constriction very slight or absent; and cross-sectional surfaces curved rather than keeled. Variable as they are, they represent a distinct series which would not be confused with other local forms (Fig. 1 *u–dd*).

Conventional scrapers, knives, drills, and other specialized chipped tools are absent. Some of the projectile points were used as knives, but edge wear is the only indication of this. The other ordinary tool is a rejected, sinuous-edged blank which resulted from a failure in projectile point manufacture. These blanks were multipurpose tools serving as a substitute for planes, knives, spokeshaves, and adzes. Choppers also occur, and show the same specialized use of selected edge portion. In contrast, none of the large flakes or other chipping debris show wear or evidence of use. Grooved axes are abundant, including three-quarter and full-grooved forms. Many are very large and have oblique grooves. Bannerstone fragments are also common. They include massive forms with slight wings and large examples with very thin and delicate wings. They are almost entirely of local shales and schists. Pestles and grinding stones of several types occur.

Superposition of forms at this site gives us some information on the relative age of a localized and peculiar Archaic complex. The field data indicate that this complex of tools derived from boulders is earlier than the local equivalent of the Laurentian; yet it has elaborate winged bannerstones, and the greatest preponderance of grooved axes of any local culture. This complex overlies stray artifacts of earlier cultures, including corner–removed quartzite spearpoints of the type I had interpreted as an Early Archaic complex at the Long site. Obviously this corner-removed type has a different significance in other areas, and specimens from Georgia are not related to those from Pennsylvania or to others from New England (Bullen 1949: 9, 54, 83). This site reflects a preference for quartzite and argillite early in the Archaic, a preference for boulder material at a later time, and utilization of many varieties of cryptocrystalline quartz in the last stages of the Archaic. Our data are not the precise information obtained in the Pee Dee Valley, and information from sites of this type can only be adequate to indicate trends, not to provide a sequential history of the local Archaic. A series as complex and as filled with discrete units as that on the Pee Dee is indicated.

The presence of a Laurentian horizon here raises the question of the validity of the Laurentian concept; this can scarcely be answered until a Laurentian assemblage is found in a deep stratigraphic column. However, sites of a general Laurentian character have a wide distribution with a similar range of diffuse artifact types, from eastern Massachusetts to western Pennsylvania (Bullen 1949: 84; Stewart and Dragoo 1954). This suggests that the Laurentian is not an artificial composite made up of discrete cultures from several distinct time horizons, but may be a valid concept. The shellmound complexes present the same problems.

The DeTurk Site and the Problem of Early Quartzite Industries

The DeTurk site at Neversink Station, near Reading, Pennsylvania, now destroyed, is the only known site with a concentration of quartzite tool types normally found scattered throughout central Pennsylvania. This large site, on the surface of a 12-foot terrace, is undated by stratigraphic or other criteria, but is most certainly post-Pleistocene and a part of the Archaic problem in typology and in age. Local quartzite from mountain outcrops is practically the only lithic material. Most of it occurs as massive tools and flakes worked by the Clactonian technique, by striking the block on an anvil without the use of a hammer. Projectile points are large lanceolate forms, boldly flaked, with convex bases, little secondary flaking, and basal edges often dulled by trimming, by breaking the edge away (Fig. 1 *f*). The most abundant tools are wedge-

shaped flakes used as knives and planes, with only slight shaping of the edges by beveling. Retouches are very often inverse. Flakes occur in a great variety of forms, but very generally have the shape and platform details of a Clactonian flake. Small bifaced knives in lanceolate, oval, and rectanguloid forms are fairly common. Choppers or cleavers and pieces broken from their edges are frequent, and are oval or crudely crescentic. Chipped quartzite adz blades with honed bits are very rare. Grinding stones and hammers seem to be absent from the complex. The most striking feature of the complex is the massiveness and crudeness of the tools and the abundant hallmarks of Clactonian technique.

Chipping floors on quartzite outcrops have also been studied, but we do not believe that the materials from them pertain only to the DeTurk complex. Projectile points are not represented in these samples, but a much wider range and a greater number of large hand tools are found in these chipping floors. Some of these are the choppers of the DeTurk site, but others are chopper types, huge planes, and pointed picks of forms which have not been found at DeTurk or elsewhere. It appears that the debris from these quartzite outcrops includes material both older and later than the DeTurk material, as well as DeTurk workshop debris.

The DeTurk tools are in many respects the crudest and most elementary artifact series which we have studied. They suggest Greenman's George Lake complex in southern Ontario and the related industries studied by Lee (Greenman and Stanley 1943; Lee 1954, 1955; Hurt 1953: 213). These complexes represent a crude Archaic which lacks many of the economic adaptations and artifact types which we think of as Archaic criteria. We presume that these Ontario industries are representative of the earliest Archaic tradition. Very few other complexes of this sort have been identified because types are nondescript forms, generally ignored in collecting and in survey. They are present, to be sure, in good samples from many Archaic sites of the mountain region and of the piedmont, but almost always intermixed with more conventional Archaic series. In fact, one is often in doubt as to whether a particular Pennsylvania specimen is a part of some later Archaic component or represents a scattering of a primitive quartzite industry on a site.

Throughout the southern and central Appalachians and everywhere in central Pennsylvania one finds a scattering of crude hand tools, cleavers and planes, of the DeTurk forms. Generally these are stray examples not on locations where other artifacts occur, or they come from tiny sites buried beneath the deep forest soil of the ridges and mountain slopes. It is usually impossible to obtain adequate samples. We have no idea of relative ages of these tiny sites, or indeed of their artifact content. They are exceedingly abundant, however. They have many parallels in other areas, but especially in highly conjectural, early lithic complexes of the southwestern and California desert areas. The one possibly fixed point in the very early archaeology of that region, the Tule Springs Site, produces crude quartzite hand tools that are suggestive of the DeTurk tradition (Harrington 1934, 1956; Krieger 1955: 202). The DeTurk site itself can scarcely be very ancient, both because of its physiographic setting and because of its projectile points. It may be a very late representative of an older and persistent cultural tradition.

One of the most notable details about the DeTurk material is its geographic distribution. The areas of the Plains Archaic tradition in the Ohio region do not appear to have any quartzite or other rough stone industries that pertain to a chopper and hand tool tradition. The areas of distribution of the DeTurk complex and of related stray tools do not produce anything resembling the Plains Archaic tradition. I think there is a very good chance that they were contemporary and filled different ecological niches. If this is likely, and the chopper and hand tool complexes pertain to the great forest areas of early recent times, then the Appalachians themselves are a most critical area. These mountain ranges have been in climax forest for untold ages, and they represent the optimum climatic conditions for most of the plant and animal species that make up their communities. They are also a region in which paleo-Indian tools are almost if not entirely unknown, except along great river valleys that penetrate their margins. They are a realm in which we may hope to find still earlier remains of a forest-culture tradition, contemporary with the paleo-Indian tradition of more open country. It is difficult to see how certain of the Eastern Archaic traditions, especially those like DeTurk, could have arisen from any background other than the crude industry of a gathering people.

CONCLUSION

As we learn more of the specific content and differentiation of local Archaic cultures, we become more uneasy about broad interpretations. The uncertainties extend even to definitions of stage and chronological period, and I am not willing to attempt restrictive definitions for the Archaic of the East. Meighan (1956: 217) has reported the most useful conclusions advanced at the Conference on Chronology and Development of Early Cultures, held at Andover during April, 1956. I shall try to relate my material to the stage definitions attempted by that conference (Johnson 1956).

An Unspecialized Lithic (Stage 1) has not been demonstrated in the East, and is represented only by Tule Springs in California. However, I suspect that such a primitive industry characterized the Appalachian Mountain district, and survived in a diluted form into Stage 3 complexes. Stage 3, an Unspecialized Archaic, is represented by the DeTurk complex. Many small sites with crude percussion industries of hand tools doubtless belong here, although some may represent Stage 1. Cultures of Stage 1 are postulated as the major antecedent of the known Stage 3 cultures. Stage 2, Specialized Lithic, is represented in the East by Clovis points and other paleo-Indian tools. We cannot point to any other cultures as having a demonstrated existence in times earlier than cultures of this stage, but believe that some Stage 3 cultures were partly contemporary with these, and that Stage 1 complexes had a prior existence. Stage 4, Specialized Archaic, is the focus of many stratigraphic and distributional problems. The Archaic of the East represents a long interval in the development of American culture, with great local and ecological diversification. Through rigorous study of numerous local representatives of the Archaic, we will ultimately arrive at historical outlines and evolutionary interpretations. However, present inadequacies do not permit us to go beyond the stage interpretations set forth at the Andover conference.

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A DECORATED BONE RATTLE FROM CULHUACAN, MEXICO*

HASSO VON WINNING

ABSTRACT

A notched and elaborately decorated human femur purchased at Culhuacan is identified as an *omichicahuaztli*, the bone rattle or musical rasp which provided musical accompaniment in Aztec funeral ceremonies for dead warriors. The incised designs consist of symbols of war, sacrifice, blood, and death, arranged in a single composition which is analyzed in terms of seven major parts: solar disc and starry sky, shield beneath the sky, eagle warrior, figure clad in slain victim's skin, earth monster, blood streams, and darts. A detailed comparison with Aztec codices and stone monuments shows that the decoration on the Culhuacan rattle is a typical expression of the religious symbolism relating to the death of warriors in late Aztec times, just preceding the Spanish conquest.

AT THE FUNERAL ceremonies of Aztec warriors it was customary for the young men who participated in the songs and dances honoring the dead to play the so-called *omichicahuaztli*, an instrument that consisted of a long hollow bone with notches. In Tezozomoc's (1944: 95) words, "le hacían sonar muy triste" (this accompaniment produced a sad sound). Some of these rattle bones (or musical rasps) have incised decoration, the symbolism of which confirms the function of the instrument. The reader is referred to the studies by Seler (1904: 672–94), who was the first to establish the identity of these artifacts on the ground of documentary evidence, and by Beyer (1934b), both of whom have thoroughly covered this subject. Linné (1934: 204–7) summarized the findings and presented the geographical distribution of this element. It should be pointed out that the *omichicahuaztli* (bone rattle or musical rasp) is not to be confused with the *chicahuaztli* (rattle stick), a staff with a hollow gourd at one end, which was filled with pebbles. Such an emblem was carried by the gods Xipe, Chalchiuhtlicue, Xilonen, Opochtli, and Mictlantecuhtli, among others, who are related to vegetation or to earth (Beyer 1934a: 199).

The *omichicahuaztli* discussed here (Figs. 1, 2), which is now in the collection of Earl L. Stendahl, Los Angeles, is outstanding because its decoration is more profuse and elaborate than that of any other that has come to my attention. It was purchased by a collector at Culhuacan, now a suburb south of Mexico City. This little town was considered a major power in the Valley of Mexico for almost three centuries until the rise of the Aztec state shifted the center of influence to Tenochtitlan. Not far from Culhuacan, which was formerly on the shores of Lake Xochimilco, is the Cerro de la Estrella where even after the decline of the Culhuas the important Ceremony of the New Fire continued to be celebrated every 52 years to initiate a new calendrical cycle. This celebration epitomized the spirit of Aztec religion.

The instrument is a left human femur, 30.5 cm. long. One end was sawn off in ancient times. A bone rattle in the Tulane University collection also has the lower extremity missing which was severed at the time the shaft was decorated (Beyer 1934b: 343). Close to the cut on the Culhuacan femur two perforations 3 mm. in diameter transverse the walls on one axis. These holes may have been drilled to attach a string with a mussel shell to serve as a plectrum for scraping the bone along the notches and thereby increasing the resonance of the rattling sound. This supposition is supported by the existence of the mosaic inlaid rattle in the Ethnographic Museum in Rome which also has a hole bored through the lower end. To this is attached a modern copper chain with a fragment of mussel shell fastened to it (Linné 1934: 205).

Part of the decoration on the front side of the Culhuacan femur is obliterated. However, the major part of the details on the other side is preserved remarkably well. It is evident that the entire decoration was laid out in such a way that most of the essential parts cover those areas of the femur not occupied by the 14 notches. When the latter were gouged, part of the sun disk, a current of blood, and a few other details were fragmented. The entire design was certainly completed before the 14 grooves were carved. It may be that at some time after the bone was decorated it was decided to turn the femur into a rattle with the subsequent obliteration of detail. In fact, at Tlahuac, to the southwest of Culhuacan, an incised femur was found bearing a representation of Ehecatl incised in a style similar to that of the Culhuacan piece, but without the notches. The Tlahuac femur, therefore, is not an *omichicahuaztli* (Henning 1913: 263–

* H. B. Nicholson, University of California (Los Angeles), read the manuscript and made helpful suggestions.

78). Some loss of detail (for example, part of the figure wearing the slain victim's skin, certain parts of the sun disk, and other elements) on the Culhuacan femur is due to the wear and abrasion caused by the actual use of the piece as a rattle. The handling and the rubbing with a mussel shell or a skull fragment are in large part responsible for the damage to the decoration.

On the whole, the layout and execution of the entire decoration reflects a perfect mastery of the religious symbolism of the time. The execution of the intricate designs betrays the workmanship of at least two craftsmen. One of them was a master of remarkable skill who excelled in carving with firm and even strokes the four major figures and the shields. His superior ability is shown in the numerous details of the solar disk, in the drawing of the feathers, and in those places where curved parallel lines appear. Another craftsman, it seems, filled in the blood streams and the darts. His workmanship was less sure-handed and resulted in slightly bent, instead of straight, lines and carelessly done details which had to be redrawn afterwards, or even corrected by gouging. Both craftsmen obviously worked from the same pattern, and it seems unlikely that essential parts were added at a later time, with the possible exception of the 14 notches. Regardless of the number of artisans who conceived and carved the composition, they were thoroughly acquainted with the great Aztec stone monuments and codices. The components inside the solar disk, the sky band, and the characteristics of the figures — to name but a few — are all carved with such accuracy that there is no doubt that the artists clearly understood the meaning of the symbols, the essential parts of which they were able to crowd into the very small space at their disposal.

A few words regarding the technique of reproducing the decoration may be apropos. A photographic rendering could only give an incomplete pictures. I therefore decided to "unroll" the design. First, the bone was rubbed with white powder to bring out the lines more clearly. This was only partially successful since the incisions, which have been made with a very fine and sharp tool, are in most places very shallow. Then a rough tracing with India ink was made on small pieces of pliable cellophane. From this a pencil tracing was made of the entire picture, and details were filled in. Because of the irregular curvature of the surface, the method of spreading the design upon a flat piece of paper resulted in a slight distortion. This discrepancy had to be corrected as far as possible. Because of the compactness of details, it was quite impossible to accommodate the necessary pencil lines. Therefore, the draft was enlarged to

FIG. 1. Decorated bone rattle (or musical rasp) from Culhuacan. Length 30.5 cm.

Fig. 2. Incised decoration on bone rattle from Culhuacan.

double size by means of a photostat. The necessary corrections and minute details were added to a tracing of this enlargement.

The composition consists of seven major parts: (1) solar disc with starry sky, (2) shield beneath the sky, (3) eagle warrior, (4) figure clad in a slain victim's skin, (5) earth monster, (6) blood streams, and (7) darts.

The Solar Disc and the Sky

The upper part of the design on the femur is composed of a band showing the sun disc and a star-studded sky. Sometimes the center of the solar disc depicts Tonatiuh, the face of the sun god (compare the so-called Aztec Calendar Stone). In this case, however, the sun god's image is substituted for the hieroglyph for gold, *teocuitlatl*, "the secretion of the sun god," or more accurately, *coztic teocuitlatl*, "yellow precious metal" (Fig. 3 *a*; Seler 1908: 266). In the codices this symbol indicates the round breast plaques made of gold (Fig. 3 *b*), and it is seen in front of the gold smith who is melting metal over a fire (Fig. 3 *c*). Thus, the meaning of this hieroglyph is well established. As far as I know, the *teocuitlatl* symbol in the center of the sun disc is unique, but logical. To the right of it are two tiny quincuxes (Fig. 3 *d*) identified by Beyer (1921: 89) as a variant of chalchihuitl (precious green stone); both chalchihuitl and quincux symbolize the sun as precious matter (Fig. 3 *e*).

The central motifs just mentioned are surrounded by V-shaped sun rays of two kinds. The simple V-shaped ray (Fig. 3 *f*) alternates with a ray whose lower ends are curved (Fig. 3 *g*). Caso (1956: 174) considered the first kind an older version which continued to be used in Aztec codices and monuments alternating with the more elaborate later form. Between every other sun ray is what Beyer (1921: 88) recognized to be a pendant of chalchihuitl which, on the Aztec Calendar Stone, are attached to a quincux (Fig. 3 *h*). On the femur, however, these details could not be accommodated in the very limited space available; therefore, only superficial indication had to suffice (Fig. 3 *i*).

One more detail worth noting is the forklike element arranged inside the outer circle of the sun disc (Fig. 3 *j*). These appear in a slightly different version on the sacrificed Xipe (Codex Nuttall 84; Fig. 3 *k*) and on the Calendar Stone (Fig. 3 *l*) where, according to Beyer (1921: 96), they denote the stains of blood that are spattered over the image of the sun after the performance of a sacrifice. The lower section of the solar disc reveals an arrangement of plumes — probably a headdress of quetzal feathers — and the arm and hand of the sun god, receiving the offering of blood from below. Tonatiuh, the sun god, emerging from a sun disc is seen on all the pages of the Tonalamatl section in the Codex Borbonicus and also in the Codex Borbonicus 3 (Fig. 3 *n*). In Codex Selden A, the sun god similarly accepts sacrificial blood (Fig. 3 *m*).

On either side of the sun disc extends a sky band, indicated by circles, standing against a dark background, shown by deeper carving. On the right side is a frieze with an eye and eyebrow rolled up at the ends, from which pend elongated elements which, in turn, again are eyes. On either side are similar protruding objects which also are eyes. This composition is no doubt the *cicitlallotl*, the starry sky in which eyes are employed to express radiating light (Seler 1904: 307). To substantiate this interpretation I refer to Figure 3 *o* taken from the Codex Borbonicus. The same composition is to be found on the sides of a large *cuauhxicalli* in the National Museum in Mexico. A starry sky frieze occurred as a main decorative element on the roof façade of the temples, consisting of several rows of conical pieces of stone whose hemispherical exterior was painted white and, therefore, stood out against the dark stucco wall, alternating sometimes with whitewashed stone representations of skulls.

The stars represented the souls of the dead warriors (Krickeberg 1956: 148). The warrior who died on the battlefield or in captivity on the sacrificial stone, or the merchant who succumbed on a journey, were given the name of *tonatiuh ilhuicac yauh*, or *tonatiuh iixco yauh* ("he who goes to the heaven of the sun," or "appears on the face of the sun"). It was believed

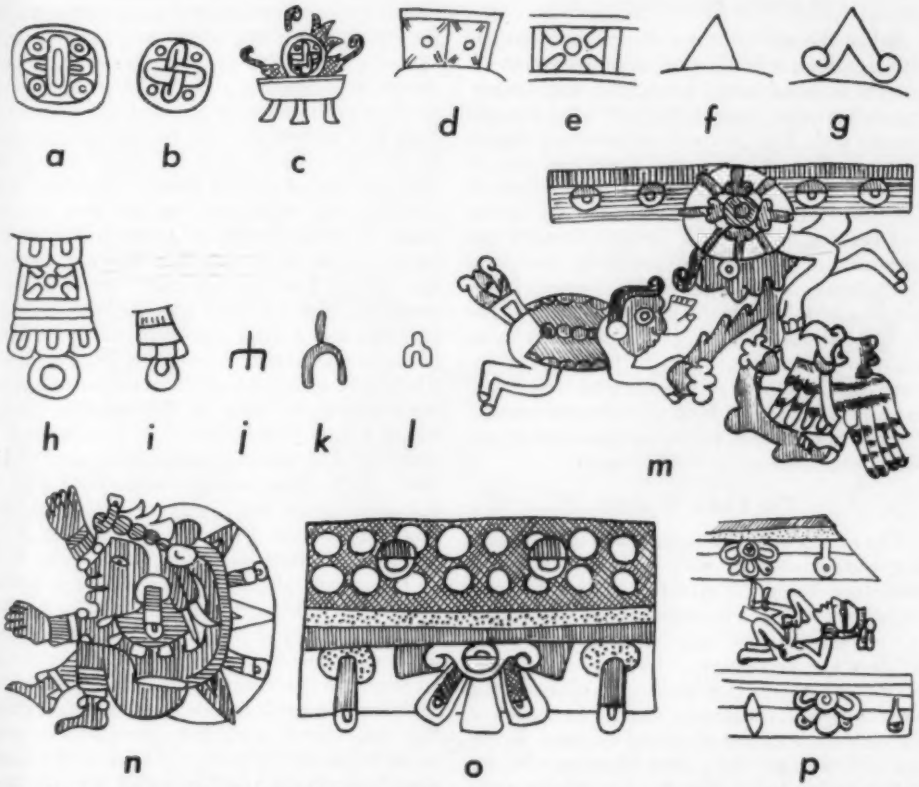

FIG. 3. Comparison of details from Culhuacan rattle with other Aztec representations. *a*, hieroglyph for gold, Culhuacan femur; *b*, hieroglyph for gold from breast plaque of a pulque god, Codex Magliabecchiano 55; *c*, hieroglyph for gold, Codex Mendoza 70; *d*, quincux, Culhuacan rattle; *e*, quincux, Aztec Calendar Stone, after Beyer; *f*, early form of sun rays, after Caso; *g*, later form of sun rays, after Caso; *h*, pendant of chalchihuitl, Aztec Calendar Stone, after Beyer; *i*, pendant of chalchihuitl, Culhuacan femur; *j*, spatterings of blood, Culhuacan rattle; *k*, blood spatterings, Codex Nuttall 84; *l*, blood spatterings, Aztec Calendar Stone, after Beyer; *m*, the sun god, Codex Selden A 12; *n*, the sun god, Codex Borbonicus 3; *o*, the starry sky, Codex Borbonicus 16; *p*, dead warriors dancing in the sky, Codex Borgia 33.

that they would not descend to the underworld but go to heaven, where they would reside in the Eastern Region, in the House of the Sun. Sahagún furthermore indicated that the deceased lords and warriors would become deities. It was the duty of the dead warriors in heaven to receive the sun on its approach in the east with expressions of joy and dances. This concept is expressed in a frieze of a temple in Codex Borgia, showing a row of half-gods dancing (Fig. 3 *p*). In fact, on the femur, there is a figure in the apparent attitude of dancing. His face is a skull and the hair is somewhat curled, the characteristic hairdo of death gods. The details are minute, but are shown as clearly as possible.

The Shield Beneath the Sky

Below the sky band is a shield, showing four circles, which is being pierced by an arrow. A current of blood passes behind the shield merging with another current that is directed towards the sun god. The pendants of the shield display down feathers (*ihuitl*) and eagle feathers. A group of four circles (*tonallo*) is the emblem of Macuilxochitl or Xochipilli, the God of Pleasure and Feasting. His shield, *tonallo chimalli*, but without the long feather pendants, occurs in the Sahagún Manuscripts in relation with Ixtlilton, the little blackfaced god (Seler 1901: 126–7). In our case, however, this picture is more likely to express war. Nuttall attempted to associate certain designs on shields with differences in rank. Seler (1904: 666) is of the opinion that this was not the case, but agrees that certain emblems were reserved for higher ranks.

The Eagle Warrior

The next prominent figure below the sky band is a warrior covered with eagle feathers, who therefore depicts a member of the Warrior Order of the Eagle Knights, who were votaries of the solar cult. His head is hidden by a butterfly device, *xolopapalotl*, which Sahagún listed as one of a number of warrior emblems which were carried on the warrior's back. At the top of the emblem is a crest of quetzal feathers. In the List of Tributes of the Codex Mendoza (64) we find a similar device (Fig. 4 *a*, *b*) with the notation that the bearer distinguished himself by having taken three prisoners. He, therefore, was one of the lower ranking chiefs. The breast plaque which appears on the femur (Fig. 4 *c*) is similar to that discussed by Seler (1890: 148). It is a golden disc with a hole in the center (*teocuitla-iti-xapo*). From the middle pends a feather band (Fig. 4 *d*). In his hand the eagle warrior wields the *macuahuitl*, a wooden flat club with obsidian or flint knives set in the edges (Fig. 4 *e*). In one of the eagle's claws is clearly seen a bowl through which passes a stream of blood. This is the *quauhxicalli*, the container in which the slain victim's blood was collected and offered to the sun.

Figure Clad in the Skin of a Slain Victim

Immediately below the eagle warrior appears a fragmentary figure which is covered by the skin of a sacrificial victim, bringing to mind the god Xipe, Our Lord the Flayed One. The skin of the flayed victim is clearly indicated by hook-like designs and by a second hand pending from the wrist. The characteristic attire of Xipe consists of a peaked cap (*yopitzontli*) which is here shown in miniature, and the fluttering end, in swallow-tail fashion, of his eardiscs. Typical of Xipe is a narrow slit eye, frequently indicated by one line only, and on the femur the eye no doubt is that of a dead person. Another characteristic, the streak running just over the eye along the entire length of the face to show the incision made at the skinning does not show on the femur. The hair is usually bound up by a strap, but here a twisted rope back of the head indicates that a mask has been tied to the front of the face (compare Seler 1908: 430, Fig. 25 *b*). The shield with the hook-like decoration apparently belongs to Xipe. In the Sahagún Manuscript, Xipe's shield displays red circles and is referred to as *ychimal teocuitla anauay* (Seler 1890: 146). The question arises how Xipe, a god of Seedtime and Planting, fits into this picture amidst solar and warlike emblems. Xipe Totec was venerated particularly at the feast of Tlacaxipehualiztli at which time the captive warriors were killed by eagle and jaguar knights in the gladiatorial combat. Their souls then qualified to enter the House of the Sun; to be sacrificed to the sun god was considered to be the most honorable of deaths. In Seler's opinion Xipe was suited in a pre-eminent way to serve as an image of the military Order of the Eagle since he symbolized for the Aztecs, not only war, but also the fate of the captive warrior's death on the sacrificial stone (Seler 1902: 177).

The Earth Monster

The last of the major figures, at the bottom, is the earth monster. Among the very important

earth deities of the Aztec pantheon, Tlaltecuhtli alone is their male representative, and he is always depicted in his disguise of a toad, or rather, as a monstrous animal. He is seen here lying flat, showing his back. His human arms and legs are drawn towards the body. On the many stone carvings of this deity, the limbs are profusely decorated with skulls; in other words, with death symbols. His hands and feet have claws instead of fingers and toes. The head consists only of a wide open mouth and is actually bent backwards so that the hair falls over the shoulders. Significantly, the hair is curled and shown like a string of half moons. Caso (1927: 48) agrees with Seler that this arrangement should not be taken for a necklace, but for the hair of the monster depicted like that of Mictlantecuhtli, the death god. The necklace of jade discs appears below the open jaw and is flanked by a curved design (eyebrows?) curling up on either side (Fig. 5 *a*). This detail is apparently the same as the one on the underside of the colossal monument of Coatlicue. There it is a band decorated with scallops (Fig. 5 *b*). Two leather bands support the skirt, which is fringed with oval-shaped objects. The fringe of the skirt is usually a row of braided leather bands, ending in shells which tinkle when in motion. On the femur, however, a row of flint knives appear. On the left side of the skirt is a skull but the counterpart on the right is unfortunately obliterated. A similar arrangement is seen on the underside of a large quauhxicalli in the National Museum in Mexico (Monumentos Arqueológicos de México 1933: 148). There, a large skull appears in the corresponding place, denoting the buckle of the belt, the *tezcacuitlapilli*, which was always worn on the back. In each of his claws, Tlaltecuhtli holds a human heart (Fig. 5 *c*, *d*) from which spouts a current of blood leading ultimately to the sun god. The earth monster is about to devour one foot of the Xipe figure. The right claw clearly grips Xipe's other foot. Tlaltecuhtli, the earth god, devours the bodies of the dead warriors.

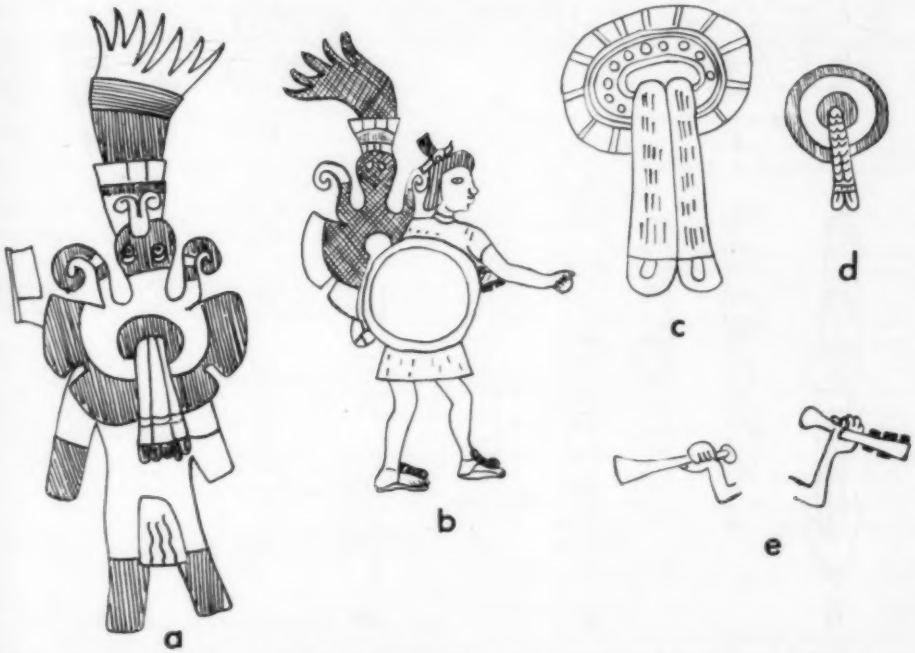

FIG. 4. Comparison of details from Culhuacan rattle with other Aztec representations. *a*, warrior's butterfly device, Codex Mendoza 22; *b*, butterfly device, Codex Mendoza 64; *c*, breast plaque, Culhuacan rattle; *d*, breast plaque, after Seler (1890, Fig. 79); *e*, obsidian sword, Codex Telleriano Remensis 37 verso, after Seler (1904: 570).

The Blood Currents

The streams of blood are indicated by an irregular punctate design and at each protrusion of the current is a chalchihuitl, to show that the liquid is precious. The punctate design also fills the upper half of the human hearts in order to leave no doubt that the liquid in the current is blood and not water. Sacred water, *teoatl*, on the other hand, was always pictured in the codices as a current with shells alternating with chalchihuitl attached to the protrusions. Blood, however, was the nourishment partaken by the sun. According to Aztec belief it had to be supplied abundantly to keep the sun moving.

The Darts

All the darts with only one exception are directed towards the earth. They vary only slightly in detail (Fig. 5 *h–n*) but all are decorated with the traditional ball of down feathers, *ihuitl*, an attribute of those who were going to be sacrificed and then enter the House of the Sun. Two arrows (Fig. 5 *i*, *j*) have what seem to be barbs. Barbed darts were used, among others, by the warriors of Michoacan (Seler 1908: 87). The small variations in detail may perhaps reflect different types of darts used by different tribes. As mentioned above, the darts are carelessly drawn and differences in detail may be due to hasty workmanship. The dart below the bowl held by the eagle warrior is interesting because it clearly penetrates the back of the head of the Xipe figure. A down feather ball is attached to the blade, which does not occur on the other darts. The rope around the head of Xipe somehow suggests the concept of a mummy pack. In Codex Fejérváry-Mayer is a picture of a dart flying at a mummy bundle which is about

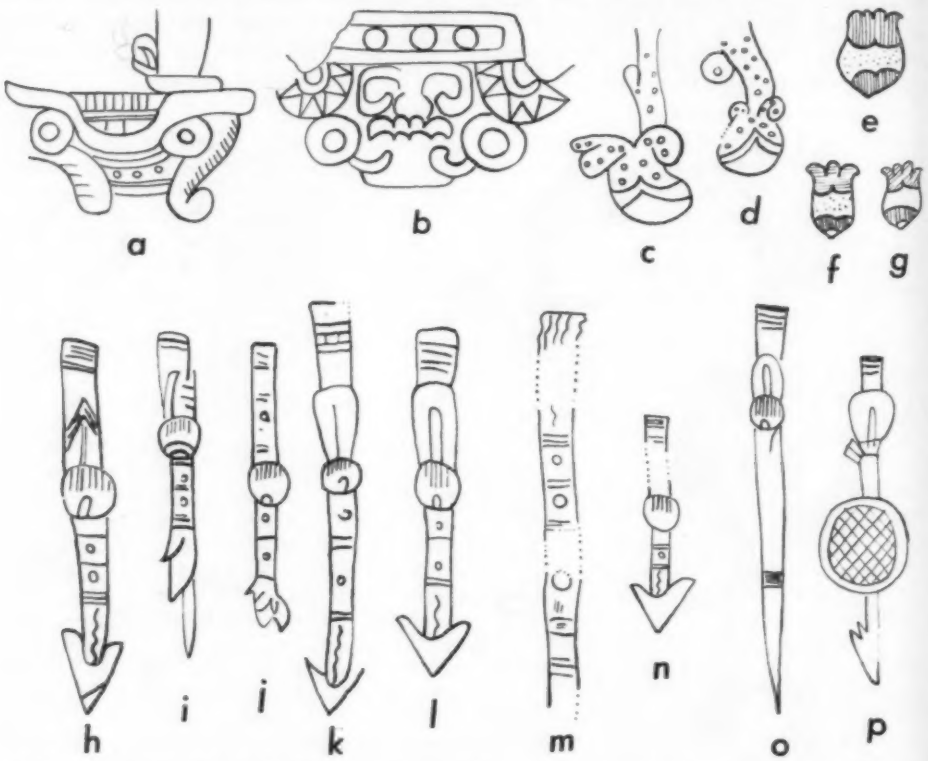

Fig. 5. Comparison of details from Culhuacan rattle with other Aztec representations. *a*, curved ornament (eyebrow?) of the earth monster, Culhuacan rattle; *b*, curved ornament of the earth monster, after Seler (1904: 792); *c*, *d*, human hearts, Culhuacan femur; *e*, human heart, Codex Borgia 23; *f*, *g*, human hearts, Codex Bologna, after Beyer; *h–n*, darts, Culhuacan rattle; *o*, dart, Codex Borbonicus 33; *p*, dart, Codex Telleriano Remensis 25, after Seler.

to be devoured by an earth monster. This death concept may have been in the mind of the artist, since indeed Xipe is about to be devoured. According to Seler (1901: 78) the flying dart denotes the *temiminalitzli*, the shooting with arrows, which corresponds to the *temiminaloyan*, the second of the nine places in the underworld.

CONCLUSION

A study of the geographical distribution of bone rattle shows that the greatest number comes from the Valley of Mexico (Linné 1934: 204–7). It is also interesting to note that this instrument was a culture element shared by Mexico and western North America where the instrument is usually called a musical rasp. Some of the bone rattles discovered by Linné may be ascribed to the Mazapan culture. A specimen in the Tulane University collection was found at the former site of Tlaltelolco and is a late Aztec production because of the character of the ornaments (Beyer 1934b: 343). The similarity of design on the femur from Culhuacan, with the decorative style of the late Mexican stone monuments and the late Aztec codices, including the Sahagún Manuscripts, points to the probability that this *omichicauaztli* was carved in the last decades before the Spanish conquest.

The designs on the Culhuacan bone rattle form a compact image, consisting of symbols of war, sacrifice, blood, and death, arranged in the traditional Aztec fashion, with the earth below and the sky at the top. The function of the bone rattles was to serve as a musical instrument in the funeral ceremonies of the dead warriors. I have attempted to show that the component parts of the design are interrelated and emphasize the funereal character of the rattle.

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May, 1958

THE KAYUK COMPLEX OF ARCTIC ALASKA

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ABSTRACT

Approximately 2400 stone and 77 bone and antler artifacts were obtained by extensive trenching of the Kayuk site, a large area on the banks of Kayuk Creek in Anaktuvuk Pass, Brooks Range, northern Alaska, where several Nunamiut Eskimo families now camp. No stratigraphy was noted and no structural features were encountered, but four fire areas were excavated. The most diagnostic artifact is the Kayuk point, a lanceolate form with finely executed parallel oblique flaking, which resembles most closely the Angostura point of the Great Plains. Other stone artifacts, some of which also exhibit the parallel oblique flaking, include blades, scrapers, angle burins, microblades, drills, and adz blades. Implements of bone and antler, mostly caribou, include harpoons, leister and fish spear prongs and barbs, and other forms common in recent and prehistoric Arctic sites. The Kayuk site is believed to have been a hunting camp used during caribou migrations through Anaktuvuk Pass by a prehistoric Eskimo group which probably wintered on the northern coast as do the modern Nunamiut. The Kayuk complex probably belongs somewhere in time between the Denbigh Flint complex and Ipiutak.

ONLY WITHIN the last decade have archaeologists penetrated the higher reaches of the Brooks Range, which lies roughly between 67 and 69 degrees north latitude and trends westward across northern Alaska from the Canadian boundary almost to the Arctic Ocean. Archaeological field studies by Solecki (1950, 1951b), Irving (1951, 1953, 1954), and Solecki and Hackman (1951) have resulted in papers on the cultural succession in that area, and the existence of sites there related to the Denbigh Flint complex, first described by Giddings (1951) from excavations at Norton Sound on the coast of northwestern Alaska. Thompson (1948), and Solecki (1951a) have also reported on the discovery of fluted points in the Brooks Range, indicating the probability of considerable cultural time depth in these northernmost mountains of the continent.

In 1956 I was invited by the late Donald G. MacVicar, Jr., to join his geological party at Chandler Lake, a large body of water a few miles north of the divide in the central portion of the range. During June and July I made an archaeological reconnaissance of the surrounding territory which resulted in a number of finds consisting of postcontact Eskimo dwelling sites, a single postcontact burial, and several lines of upright stones indicating the former locations of caribou drives or corrals (*kangiak*). On one overland traverse to the east I reached Anaktuvuk Pass, where at present several families of Nunamiut Eskimos are encamped. There an Eskimo gave me a portion of a well-flaked leaf-shaped projectile point, which he had recently found within the boundaries of the present dwelling area. That find led to the discovery of several other artifacts at the same location, and during the latter portion of the 1956 season I spent several days at Anaktuvuk Pass, further exploring the site. Preliminary excavations were discontinued after the accidental death of MacVicar at Chandler Lake late in July, 1956. In 1957 I returned to Anaktuvuk Pass, and during the summer resumed excavations at the Kayuk site. My companion for the second season was L. J. Pospisil of the Department of Anthropology, Yale University.

DESCRIPTION OF THE SITE

The Kayuk site lies a few hundred yards south of the summit of Anaktuvuk Pass (68°8′N., 151°43′W.), on the southwest bank of Kayuk (or Contact) Creek, which bends east and south in the pass. This stream forms a headwaters branch of the John River, which in turn feeds the Koyukuk, a large tributary of the Yukon. A small tundra lake lies immediately north of the divide less than half a mile from the site. This drains into the Anaktuvuk River, a tributary of the Colville, which empties into the Beaufort Sea. In the site area Anaktuvuk Pass is probably two miles wide, a part of a large glacial valley which faces north toward the tundra barrens, and south to the spruce forests of the John River. The Kayuk site has an elevation of approximately 2100 feet, while on either side of the valley mountains rise abruptly to peaks several thousand feet above the pass.

The climate of the Anaktuvuk Pass region is typically inland Arctic, although even in winter minus temperatures are not as extreme as those in the lowland interior of Alaska. Rausch (1951: 151) states that during the coldest months the temperature "rarely falls as low as –50°F." Annual precipitation is slight, averaging only a few inches (Rausch 1951: 151), and in winter wind-packed snow and surfaces of frozen streams are ideal for travel. During the short summer season mosquitoes and other stinging insects are far less numerous than in many other Arctic

areas and, in spite of the mountainous terrain, the region is well suited to human habitation. The vegetation in the pass consists of dry alpine flora, few plants reaching a height of more than several inches with the exception of willows (*Salix* sp.) which grow thickly along the banks of Kayuk Creek. There the willows obtain a maximum height of 10 or 12 feet and are an important and necessary source of fuel for the Nunamiut Eskimos. Sedges, grasses, mosses, and lichens are the dominant flora, forming a cover 2 to 6 inches in depth on the site itself. The nearest spruce occur 15 or 20 miles south-southeast of Anaktuvuk Pass near the head of Savioyok Creek. This timber lies beyond relatively rough terrain, and the present Nunamiut prefer to obtain spruce by traveling in winter down the John River to the wooded mouth of Hunt Fork, 40 miles south-southwest of the pass. These journeys are made by dog team on the river ice, the time from Anaktuvuk Pass to Hunt Fork requiring less than five hours under ideal sledding conditions.

Anaktuvuk Pass has apparently been known to generations of Eskimos as a hunting ground for caribou which even today are the staple of Nunamiut economy. This broad mountain valley, with its gentle approaches, is traversed annually by thousands of these animals (*Rangifer arcticus stonei*), and the quantity of caribou bones occurring archaeologically at various sites in the area, including the Kayuk site, indicate that caribou have been hunted extensively in the pass for probably several millennia.

The Kayuk site is slightly more than one-fourth of a mile in length, with a maximum width of approximately 100 feet. The long axis of the site runs generally north and south. Four concentrations of cultural material occur, designated as Areas I, II, III, and IV. These areas of concentration are separated by distances ranging from 580 to 120 feet, the dimensions of the largest area being 485 by 50 feet. The site is situated along the top of a low bench which varies in height from 20 to 40 feet above the present bed of Kayuk Creek. One portion of the site is today eroding into the stream; the remainder, however, is several hundred feet removed from the creek except during periods of extremely high water. Beneath the culture bearing level, the soil to a depth of at least 4 feet consists of stratified lenses of sand and gravel. The bench upon which the site occurs is apparently an alluvial terrace, sands and gravels being well sorted in all areas tested. Several large boulders on the northern perimeter of the site are probably of glacial deposition. Permafrost is present at varying depths in the site. In one trench frozen soil was encountered 9 inches below the present surface, while another trench was excavated to a depth of 4 feet without striking frost. These differences appear to be the result of drainage factors.

Archaeological remains within the site are unstratified and are concentrated in a thin homogenous layer which extends from immediately beneath the sod to a maximum depth of 12 inches. A great majority of all artifacts recovered occurred within 6 inches of the surface. In spite of the shallow character of the artifact bearing level, implements and cultural features have been largely undisturbed since their original deposition, the thin veneer of tundra vegetation having served as adequate protection from erosive agents. In fact, the first artifact belonging to the Kayuk complex was not recovered from the site until several seasons of recent Eskimo occupation had worn trails through the sod. Testing of the areas of artifact concentrations indicated that identical cultural material existed in each of the four areas. An exception was encountered in the recovery of a disproportionately large number of antler and bone implements from small portions of Areas III and IV. Stone artifacts in association, however, were generally of the same types as those found in other areas of the site. In the process of preliminary testing, Areas I and II produced less archaeological material than the remaining two areas, both in terms of artifacts recovered and features such as fire hearths and concentrations of camp refuse. Accordingly, trenching was conducted in Areas III and IV, while testing of Areas I and II was continued during the season for purposes of control.

Trenches were oriented by compass on either a north-south of east-west long axis, and excavated according to a system of horizontal 5-foot squares. In one instance two trenches were crossed at right angles, thus increasing the reliability of sampling in an area of particularly heavy concentration of cultural material. A numbering system was used to designate each trench, and each horizontal quadrangle within a trench. For statistical purposes, all stone spalls regardless of size were recovered from arbitrary levels measured in inches from two squares in Trench I. Subsequently, only a sample of the total number of unretouched spalls was collected. Levels, either arbitrary or stratigraphic, were not used elsewhere in the excavation. Each artifact was measured according to its horizontal and vertical position when found. Cultural features, including fire hearths, were measured in relationship to their positions in the several trenches, sketched to scale, and when practicable, photographed. Trench wall profiles were also recorded by means of scale drawings. Each trench was excavated to a depth well below the vertical limits of cultural remains. Implements or other cultural evidence were in no instance found to extend to a depth greater than 12 inches below the present ground surface. Vertical depth of excavation did not usually exceed 24 inches, although portions of two trenches were excavated to a maximum depth of 48 inches. In both of these trenches cultural remains were not encountered at depths greater than 9 inches below the surface. Five trenches, totaling 185 feet in length, were excavated during the field study. In addition to the archaeological material recovered from the trenches, large numbers of artifacts were collected from the site area by Eskimos. I was able to exercise a fair degree of control over this enthusiastic if rather unscientific digging, and in many instances quite accurately determined both the horizontal and vertical provenience of artifacts so found.

Features

No evidence of dwellings or burials have yet been discovered in association with the Kayuk complex. Remains of storage or cache pits, or subsurface outlines of walls, floors, or post holes are notably absent from the site. Well defined features consist of three hearths containing stream-worn cobbles from the nearby creek, and a large lens of fine gray ash and humus, all of which occurred in Area IV, the southernmost and largest of the four areas of concentration of cultural remains within the boundaries of the site.

Feature 1, a hearth, oval in shape, contained 40 water-worn cobbles, two of which protruded slightly above the sod. The cobbles were neatly laid within the hearth, forming a solid, closely packed layer of stones, measuring 6 inches in vertical depth, and 42 by 24 inches horizontally. The long axis of the hearth lay north and south. In size the cobbles ranged from 3 to 6 inches in maximum dimension. The basal portions of two typical Kayuk projectile points of dark chert were found in situ in crevices between the lowermost hearth stones at a depth of 6 inches. The two points lay less than 3 inches apart near the northwestern perimeter of the fireplace. Several unworked spalls, also of dark chert, a long keeled scraper of light gray chert, and a fragment of an unidentified implement of bone were found at depths of 5 to 6 inches within a 24-inch radius of the hearth. Two of these artifacts including one of the blades, well worked along two edges in a style characteristic of Kayuk complex stone working (Fig. 2 *v*) occurred immediately outside of the northwestern perimeter of the hearth within a few inches of the projectile points discovered among the hearth stones. Feature 1, together with the two projectile points it contained and the four additional implements recovered close by is one of two examples encountered at the site of well defined cultural features in association with representative artifacts of the complex. Unfortunately, it was impossible to obtain a usable radiocarbon sample from this hearth. Charcoal and ash occurred in the form of a powdery layer well mixed with humus, adhering to the surfaces of the stones. The small quantity of carbon present, and the total absence of odds and ends of larger charcoal fragments and partially charred bits of wood indicate that this fireplace was used for an extremely brief period, and that the fire was tended in such a manner that the fuel was almost entirely consumed.

Features 2 and 3, hearths, also extended to a maximum depth of 6 inches below the present surface. Feature 2, roughly circular in shape, was 30 inches in diameter, and contained four water-worn cobbles, the largest of which was slightly less than 8 inches in length, and three fire-broken fragments of stone. This hearth was 3.5 inches below the surface. Unlike Feature 1, the stones in this instance were haphazardly placed. Three fragments of slightly charred caribou bone and a considerable amount of charcoal were found among the stones. Radiocarbon Sample A (*Salix* sp.) was recovered from this hearth. No implements were found in association. Feature 3 was discovered well down the side of the bench upon which the site is situated in the lowermost square of a trench which was extended down the slope on the eastern side of Area IV. Four small cobbles and six fire-broken spalls mixed with a small amount of charcoal were encountered at a depth of 5 inches. The stones and charcoal were scattered over an area 18 inches in diameter and slightly more than 1 inch in vertical thickness. No artifacts were found in association, nor was there sufficient charcoal present for a radiocarbon sample. Thirty broken caribou bones, including four mandibular fragments containing teeth, were found together 22 inches south of this hearth. These bones extended from 6 to 12 inches below the present surface.

Feature 4, a lens consisting of fine ash and humus was found in Area IV near the eastern perimeter of the site. This feature, oval in outline, measured 5 feet in length, slightly more than 2.5 feet in width, and had a maximum vertical thickness of 6 inches. In depth it extended from 4 to 10 inches below the present surface. The long axis lay north and south. Slightly more than 400 broken, unworked fragments of caribou bone were found scattered throughout the ashy lens, and at depths of 4 to 10 inches in the immediately surrounding area. A very small percentage of these unworked fragments show evidence of charring. A large number of purposely fractured caribou long bones are represented in this collection, although other skeletal material present includes caribou vertebrae, ribs, scapulae, and mandibular fragments. In addition to the unworked bone, 85 implements of caribou bone and antler, and chipped stone were recovered from the ashy lens, as well as

numerous stone spalls. Thirty-four artifacts of bone or antler include three arrow heads, one fish spear center barb, one adz head, one perforating tool, two unidentified implements, and 26 fragments which show evidence of cutting or incising. Approximately one-third of the total number of bone or antler artifacts associated with this feature are slightly charred. The remainder were apparently not subjected to fire. Fifty-one artifacts of stone are represented by seven projectile points, eight scrapers, 20 blades including an inset side blade and several discoidal blades, and 16 spalls retouched along one or more edges. These implements, together with those of bone and antler, were well distributed vertically and horizontally throughout the lens.

This large well-defined feature is quite unlike the smaller hearths and other scattered evidence of fire making found elsewhere in the site. At first glance the relatively thick homogenous layer of fine ash and humus, and the lack of smaller inclusive lenses suggests the remains of one large fire. The number of artifacts, however, and their vertical distribution does not substantiate this impression. I think it more probable that the feature represents a large fireplace or fire area in which numerous small fires were made, and which was used intensively for a relatively short time, and then permanently abandoned. No hearth stones were found in association, nor was there evidence indicating that fires were placed in an intentionally excavated pit or trough. It appears likely that a shallow natural depression on the old ground surface was utilized. Such a depression would hold the ash within a specific area, and would also serve as a repository of discarded or lost implements and camp refuse. No charcoal occurred in this feature, and the powdery wood ash well mixed with humus was unsuitable for radiocarbon assay.

In addition to the features described above, each of the four areas of concentrated cultural remains in the Kayuk site contain poorly defined lenses of stained and fire-blackened earth, and scattered fragments of charcoal. With few exceptions fire making at this site appears to have been accomplished with little or no use of hearth stones. Fires were usually small and temporary, and fuel apparently was not abundant, as witnessed by the lack of partially carbonized wood in the fire places. The remains of these surface fires were soon scattered, leaving as evidence stained humus, and more rarely small pockets of ash and charcoal. Radiocarbon Sample B was recovered from one such find. The nature of the hearths, the archaeological absence of dwelling remains, and the shallow and unstratified cultural layer all strongly suggest that this early occupancy of the Kayuk site was neither prolonged nor continuous.

THE ARTIFACTS

The Kayuk collection contains approximately 2400 specimens of stone, the majority being spalls or flakes which show little or no retouching. Only a sample of the unworked stone spalls encountered in the site was removed, although nearly all examples of antler, bone, and tooth were collected; hence, these materials are disproportionately represented in the present series. I estimate that the occurrence in the site of antler, bone and tooth is somewhat less than 8% of the total number of specimens showing evidence of human workmanship or usage. The distribution of artifacts in the site is characterized by an even vertical distribution, a general horizontal dispersion of implements of stone, and a more restricted occurrence of implements of antler or bone. Most bone and antler artifacts were found in two relatively small sections of Areas III and IV, and nearly all fragments of unworked bone, antler, and tooth occurred in two deposits in Area IV. Stone artifacts however, were more widely scattered.

Stone implements. All stone artifacts from the site were manufactured by percussion or pressure flaking techniques with the exception of a heavy, elongate piece of waterworn silt stone which shows slight evidence of grinding along one edge. The great majority of stone implements are of chert, ranging in color from light gray to black. Bedrock throughout the area is sedimentary, consisting of limestone and conglomerate, and I assume that chert is available in the immediate area of Anaktuvuk Pass, although I found no natural deposits of this material during the course of the field study. Eighty specimens of obsidian were recovered from the site, including six projectile points, five scrapers, one small core, one blade, and 67 spalls of which some are retouched. Most of the obsidian is dark and quite transparent, although a few pieces are dull black, and two specimens are reddish brown. The unworked surfaces of several spalls suggest that obsidian was carried to the site in pebble form. As few igneous deposits are known

in the Brooks Range, I think it quite likely that the obsidian found at Anaktuvuk Pass was brought in from areas of volcanic activity several hundred miles to the south and west, perhaps from Seward Peninsula, although this conclusion is tentative.

For convenience I have divided implements of stone into a minimal number of categories including projectile points, blades of several types, scrapers, burins, microblades, drills, and adzes. In addition, I have placed in a single large category spalls which have been retouched, and presumably used for a variety of purposes. These types are preliminary, and further detailed analysis may somewhat alter my present typological system.

Projectile points. This category contains 121 specimens, all of which are lanceolate in general outline. Most are quite large, 12 complete specimens ranging from 5.5 to 12.5 cm. in length. Over 80% of all projectile points recovered are characterized by parallel or slightly expanded sides, thick oval to diamond-shaped cross section, convex base, and finely executed parallel oblique flaking which extends downward from left to right across both sides of the blade (Fig. 2 *b–g, i–l*). In most instances this flaking was accomplished by removing small flakes from both edges rather than the removal of a single flake extending completely across the blade. Parallel oblique flaking, while most common among projectile points of the Kayuk complex, in some instances was employed in the manufacture of other implements as well, including blades, scrapers, and drills (Figs. 1 *s*, 2 *p, r, v, w*). Edge grinding of projectile points is absent with the exception of the three examples of basal portions of obsidian points, all of which are well ground. In the most complete obsidian example grinding extends upward from the base along both sides for approximately 2.7 cm. Four projectile points are roughly made, appear heavily patinated, and except for general shape are quite unlike the remainder of the collection (Fig. 1 *a*). Two points exhibit transverse parallel rather than oblique flaking, although in the example shown (Fig. 1 *m*), the flaking on the obverse face tends to approximate the typical oblique style. Five points depart from the common form in having straight rather than convex bases (Fig. 1 *h*). Ten specimens exhibit quite extensive basal thinning, accomplisehd in most instances by the removal of a single narrow vertical or nearly vertical flake from only one side of the blade. Two points (Fig. 1 *q*, r) show exceptional departures from the other samples. One (Fig. 1 *q*) is fluted on one side by the removal of a broad vertical flake. The obverse side of this point is similarly fluted, but in this instance the flute is partially obliterated by the intrusion of three small oblique flakes which enter from either edge. No basal edge grinding is present. In cross section this point slightly approaches the "hollow-ground" appearance of the Folsom type. Its general form, however, does not closely approximate either Folsom or Clovis fluted in spite of the fluting and the slight tendency toward similarity in cross section. The other (Fig. 1 r) is an example in which two long parallel oblique flakes have been removed from one side of the base. The obverse side is not thinned, and no basal edge grinding is present.

Blades. The term blade refers here to thin flaked implements presumably used for cutting, and in the instance of inset end or side blades, for penetrating, and not ordinarily as in Old World usage, to narrow, prismatic flakes struck from specially prepared cores. I have further subdivided blades into four categories including discoidal or ovate forms: angular blades of a variety of shapes, usually quite large, some of which closely approach the projectile point category, and in fact may eventually be placed there; small end blades for insetting in antler projectile points; and small side blades, also for insetting in points of antler.

Twelve examples are discoidal or ovate (Fig. 1 *o, p*). All are bifacially flaked, are finely retouched around the edges, and quite thin in cross section. The largest is 6.5 cm. in greatest dimension. I do not know how they were used, although one specimen, rather plano-convex in cross section, fits well the bone adz head shown in Figure 3 *l*.

Angular blades are represented by 123 examples (Figs. 1 *n, s*, 2 *u, v*). The members of this subdivision range in shape from almost lanceolate to semilunar, and exhibit much variation in degree and technique of manufacture. One hundred and two are bifacially worked. Flaking varies from fine secondary retouching on some examples to the removal of a few large spalls from others. Most Kayuk complex stone work is impressive in size. This is particularly noticeable in a high percentage of blades. The length of the longest complete specimen is 11.9 cm., although fragments of others suggest that many blades of the complex were originally con-

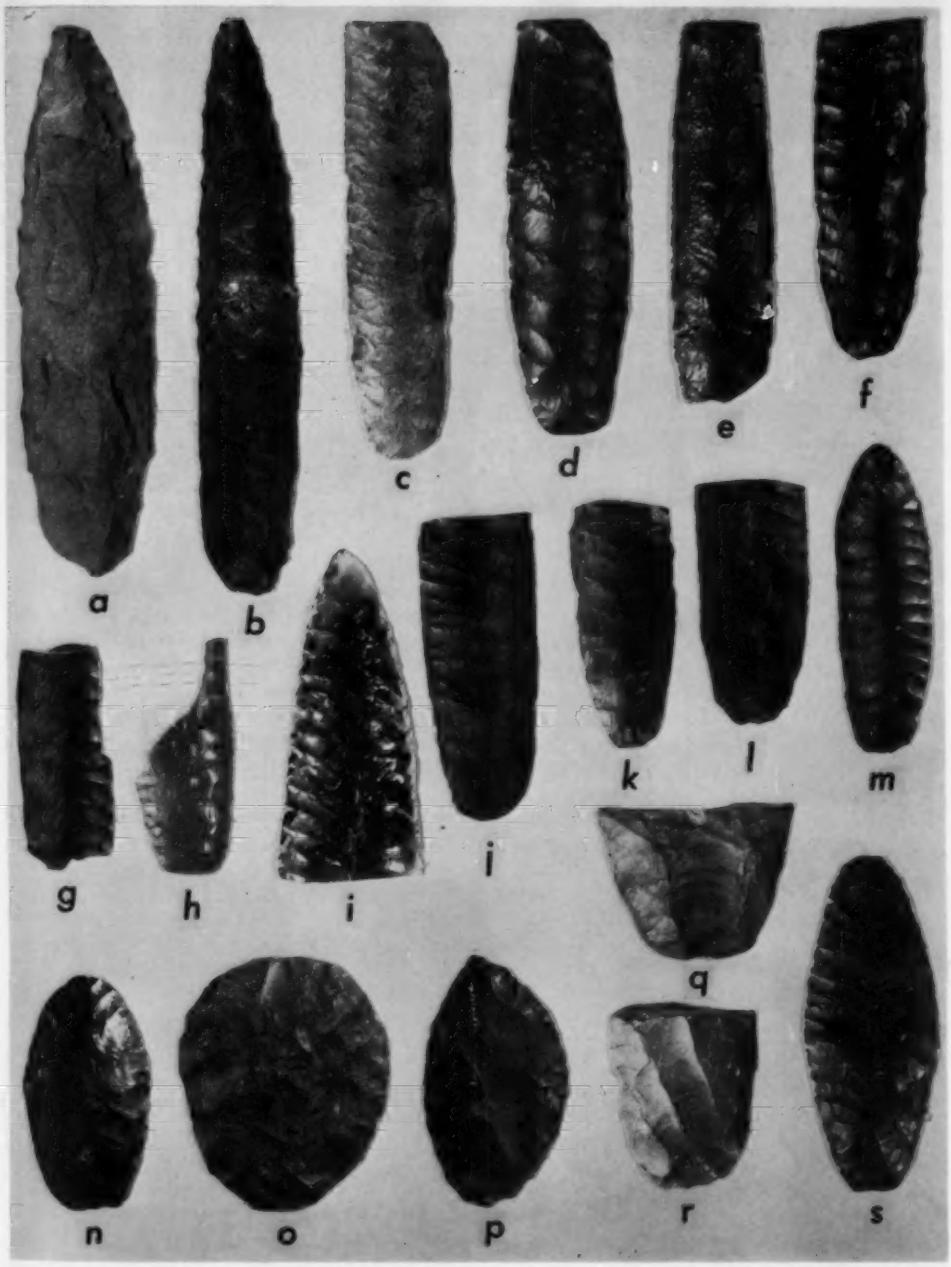

FIG. 1. Projectile points and blades from the Kayuk site. *a*, roughly flaked lanceolate point; *b–g*, typical Kayuk points; *h*, point with straight base; *i*, typical Kayuk point made of obsidian; *j–l*, typical Kayuk points; *m*, transversely flaked point; *n*, *o*, *p*, blades; *q*, fluted base of a point; *r*, diagonally thinned base of a point; *s*, blade. *a–g*, *j–l* to scale, length of *a*, 9.5 cm.; *h*, *m–p*, *s* to scale, length of *h*, 4.3 cm.; *i*, *q*, *r* to scale, length of *i*, 4.2 cm.

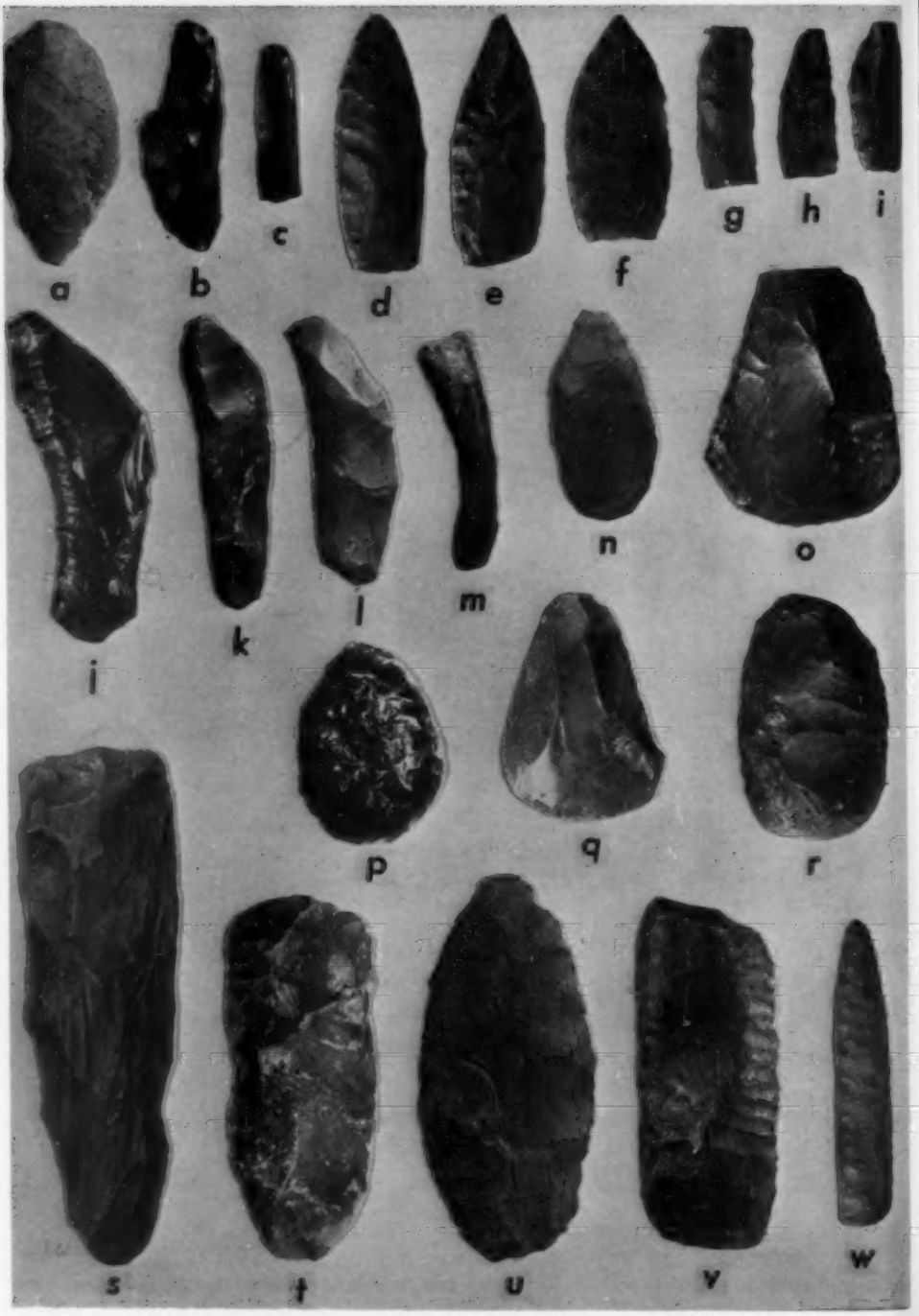

FIG. 2. Stone artifacts from the Kayuk site. *a*, *b*, angle burins; *c*, microblade; *d–f*, inset end blades; *g–i*, inset side blades; *j–m*, side scrapers; *n*, flake scraper; *o–r*, end scrapers; *s*, *t*, adz blades; *u*, *v*, blades; *w*, drill. *a–i*, *w* to scale, length of *b*, 3.7 cm.; *j–r* to scale, length of *j*, 8 cm.; *s–v* to scale, length of *s*, 15 cm.

siderably longer than this. Examples of this subdivision were probably both hafted (Fig. 1 *n*, *p*, *s*), and in the instance of the larger examples, hand held.

Small inset end blades (Fig. 2 *d–f*), and side blades (Fig. 2 *g–i*) are represented by 17 examples. Five of 11 end blades are flaked on one face only except for slight marginal retouching on the flat or unworked side. Three of these examples are slightly convex in longitudinal cross section. The largest complete end blade is 4 cm. in length. The six inset side blades are bifacially worked. Only fragmentary side blades were recovered. An examination of the slotted antler and bone projectile points suggests however that blades of this category were slightly smaller than inset end blades. Although the several examples of slotted antler arrow heads recovered from the Kayuk site did not contain blades, the excellent series recovered at Point Hope by Larsen and Rainey (1948) conclusively demonstrates the use of these small flaked blades in prehistoric Arctic Alaska.

Scrapers. Readily identifiable scrapers, almost all of which are retouched on one face only, are represented by 33 examples. These include four end scrapers, triangular in cross section, which approach a keeled form (Fig. 2 *r*); 12 end scrapers, most of which are plano-convex in cross section (Fig. 2 *o–q*); two flake scrapers or knives nearly flat in cross section (Fig. 2 *n*); and 15 elongate side scrapers (Fig. 2 *j–m*) ranging in cross section from trapezoidal to plano-convex, eight of which are crescentic in shape (Fig. *j, l, m.*)

Burins. Three angle burins were recovered from the site. One (Fig. 2 *b*), plano-convex, and trimmed on one edge closely resembles those found at Cape Denbigh (Giddings 1951). The remaining two, one of which is a rather doubtful example (Fig. 2 *a*), appear to have been shaped from the basal portions of projectile points. Note the parallel oblique flake scars on the specimen shown. The burin not pictured is considerably smaller than the others, and is trimmed on two edges. The length of the largest is 4 cm.

Microblades. Two examples were found in the Kayuk site. The longest, 2.5 cm. in length, shows use without retouching along the sides, and appears slightly retouched on one face at the upper end (Fig. 2 *c*). The other is 2.2 cm. long, and is apparently similarly retouched at one end. A few larger prismatic blades were collected, although no prepared cores were found in the site.

Drills. Two fragmentary drills were found, the longest of which (Fig. 2 *w*) is 4.7 cm. in length. Both are diamond-shaped in cross section and exhibit excellent parallel oblique flaking.

Adz blades. This category contains two large examples (Fig. 2 *s, t*). Both are bifacially worked from rather coarse sedimentary rock; one (Fig. 2 *t*) is of quite soft material, which makes its use as an adz questionable. Both specimens have been roughly shaped by the percussion technique. The longest is 15 cm. in length.

Antler and bone tools. In this relatively small category, almost all specimens are caribou antler or bone. A dense, heavy adz head of bone (Fig. 3 *l*) is probably representative of a large sea mammal, and a well finished boring or punching implement appears to have been manufactured from fossil ivory. Most of the implements are of antler, a material which is still commonly used for a variety of purposes by the Nunamiut. No artifacts of tooth were found in the site, although a single midsection of beaver incisor was recovered.

The collection contains 77 artifacts of bone and antler including two harpoon heads (Fig. 3 *a, o*), one leister prong (Fig. 3 *b*), three fish spear barbs (Fig. 3 *j, k*), one fish spear center barb (Fig. 3 *i*), four arrow points (Fig. 3 *c, d*), one flint hammer head (Fig. 3 *n*), two adz heads (Fig. 3 *l*), one wedge (Fig. 3 *p*), one ice pick, three awls or punching implements, two needle-like objects which are not eyed (Fig. 3 *h*), one well finished object decorated with incised lines (Fig. 3 *c*), two unidentified conically drilled fragments (Fig. 3 *m*), and 34 cut or incised fragments (Fig. 3 *f, g*). The remainder consists of objects which I am as yet unable to identify. Most of the implements listed above are not uncommon in the American Arctic, both in recent and prehistoric times, and require no particular descriptive explanation. A few, however, deserve special mention. Of the incised and cut antler and bone fragments, 15 pieces of antler are deeply incised, obviously by the use of a very sharp tool. This incising is also present on several finished implements including arrow points and the single decorated object. Burins or similar flake artifacts must have been used in this antler working, but the percentage of burins or other suitable tools is extremely low in the stone

series. It is possible that the present collection of burins is not representative, and I think equally possible that the antler incising was accomplished by other means, perhaps with the very sharp unretouched obsidian spalls. In any event, this problem is yet to be resolved.

The specimen in Figure 3 *a* probably represents two unfinished harpoon heads of the generalized "male" type, the slight protuberance near the center being perhaps a line guard. This object is of antler, is 23 cm. in length, and is generally oval in cross section, the obverse side tending to be more flat than the face shown. The other harpoon head recovered from the site (Fig. 3 *o*) is of a type which I believe to be previously unreported. It is of antler, 7.7 cm. in length, and almost flat on the side not shown in the figure. A deeply hollowed medial open shaft socket extends upward 3.5 cm. from the tip of the spur on the flat or ventral face. In general outline it

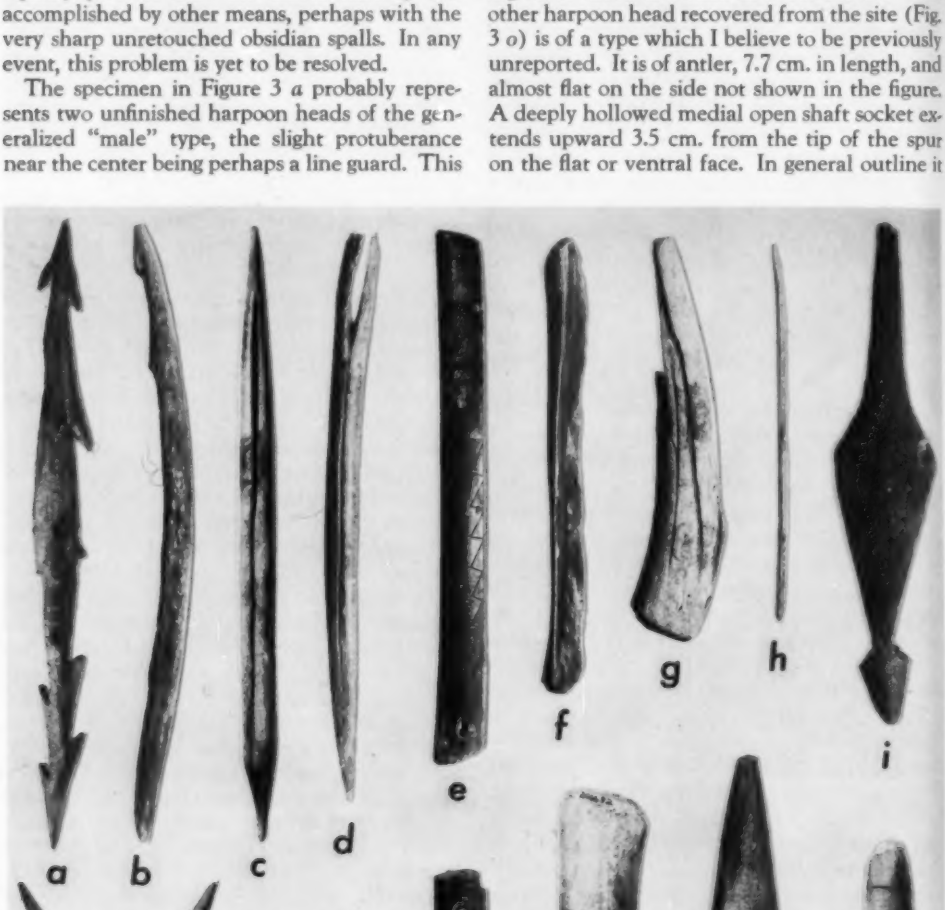

Fig. 3. Bone and antler artifacts from the Kayuk site. *a*, unfinished and not yet separated harpoon heads; *b*, leister prong; *c*, *d*, slotted arrowheads; *e*, bone with incised decoration; *f*, *g*, incised antler; *h*, pin; *i*, center prong of fish spear; *j*, *k*, barbs for fish spear; *l*, adz head; *m*, drilled object; *n*, flint hammer head; *o*, harpoon head; *p*, wedge. *a*, *b*, *f*, *g* to scale, length of *a*, 23 cm. *c*, *d*, *h*–*k*, *o* to scale, length of *i*, 11.2 cm.; *l*-*n*, *p* to scale, length of *l*, 7.3 cm.

vaguely resembles an example of Thule Type 1 (Mathiassen 1927, Pl. 1 *l*) but differs in several significant respects including the absence of a line hole.

Of four antler arrow heads (Fig. 3 *c*, *d*), two are slotted along two sides, one contains an end slot, and one is too fragmentary to determine its original form. These arrow heads are quite like those from Ipiutak although two of the Kayuk specimens appear to be more deeply incised for a greater distance along the shaft than those reported from Ipiutak. In this respect the Kayuk arrow heads perhaps fall between Ipiutak and the long, deeply incised examples from Trail Creek Cave (Larsen, 1951: 74). Three of the points are oval in cross section, while the fourth (Fig. 3 *c*) is roughly triangular. Length of the longest complete specimen is 14.7 cm.

The decorated bone object (Fig. 3 *e*) is incised with a well executed zigzag design on one face. It is thin oval in cross section, slightly bowed, and thinned at each end on the undecorated face. In general shape it resembles a snowshoe crossbar, although the rectangular hole at one end suggests its possible use as an item of personal adornment. It is 13 cm. in length.

DISCUSSION

The content of the Kayuk site, together with the negative evidence, presents a valuable if admittedly limited insight concerning the nature of an early Arctic culture. The members of the society were primarily hunters, well equipped with a variety of tools with which to kill and prepare large mammals. The Kayuk site was a caribou hunter's camp, situated along a major seasonal highway of those animals. Since, however, caribou were not to be found in the high valley at all times of the year, the camp was probably temporary. Dwellings were surface structures, perhaps of hides stretched over willow frames in the manner of a more recent Brooks Range pattern. The caribou were followed from one season to another, but at certain periods of the year when the animals were widely scattered, such as at calving time, the hunters must have turned to other pursuits. Large fish were taken, as witnessed by the long fish spear center prong and fish spear barbs, and it is most probable that at least occasionally sea mammals were hunted. The socketed harpoon head must certainly be a salt water type. In addition, there is the adz head which appears to be of sea mammal bone. It is possible that both of these artifacts represent trade, but I think it unlikely that a harpoon head, specifically manufactured for the purpose of killing large sea game, would be of any particular value to an exclusively inland dwelling people. Historically, there is ample evidence of the contact of Brooks Range peoples with outlying areas. Larsen and Rainey (1948: 30–6) in a summary of written accounts, and in commenting on data obtained by them from living informants, state that formerly the inland Eskimos of this region traveled extensively at certain seasons, reaching the coast at various points including the mouth of the Colville River to the north and the mouth of the Noatak River west and south. More recently Pospisil (1958, personal communication), working among the present Nunamiut at Anaktuvuk Pass, obtained further evidence relative to former coastal journeys. Pospisil's informants said that Brooks Range Eskimos often wintered on the northern coast, and participated in hunts on the sea ice with coastal peoples. It is not, therefore, unlikely that similar travel occurred in prehistoric times. Foreign contact is also represented by the obsidian found in the Kayuk site. This material probably came from a distance far greater than the nearest tide water to the north, and most likely reached the Brooks Range as an article of trade.

Reconstructing a fairly accurate picture of certain aspects of the culture represented in the Kayuk site is much less difficult than relating the Kayuk complex to other cultures, and placing it in proper spatial and temporal perspective. The early hunters who camped at the site had a knowledge of several important tool-making techniques, most of which are present archaeologically in both North America and Asia. These include the manufacture of microblades, angle burins, antler arrowheads containing inset side or end blades, fluted points, and lanceolate projectile points flaked diagonally across both faces. Viewed as a whole, however, the Kayuk collection does not closely resemble any artifact series yet reported from either continent.

Specific trait comparisons of the present material with that from other sites in the north show certain resemblances, most of which suggest the sharing of common traditions rather than specific cultural relationships. In the northwestern American Arctic burins and microblades are represented at the Cape Denbigh site (Giddings 1951), the Engigstciak site near the Yukon arctic coast (MacNeish 1956), and at

other sites in the Brooks Range including Tuluak Lake less than 20 miles north of the Kayuk site (Irving 1951, 1953). In these instances, however, the percentages of burins and microblades are considerably higher than at Kayuk, and with few exceptions other diagnostically important artifacts are unlike Kayuk implements.

The single artifact type which sets the Kayuk complex apart is the large, characteristically flaked projectile point of which there is a large series. Unstemmed lanceolate points have been reported from numerous sites in the American Arctic as well as from more southern interior regions. Kayuk points, however, differ from any single described type either in cross section, basal shape, outline of the sides, degree of edge grinding, or flaking technique. The closest resemblance to the Kayuk point in North American collections is probably the Angostura point first described from a site in South Dakota (Hughes 1949: 270, 274). Type specimens of Angostura points differ from typical Kayuk examples in being edge ground, thinner in cross section, and having straight or convex bases. In the north, lanceolate points from Artillery Lake, Sandy Lake, Great Bear River, and Little Arm sites (MacNeish 1951, 1954, 1955, and personal communication) show some resemblance to Kayuk points, as do points from Cape Denbigh, Trail Creek Cave, and Ipiutak, but in each instance are either dissimilar to Kayuk points in edge grinding, cross section, flaking, size, or other characteristics. A recent summary by Tolstoy (1958) indicates a considerable spatial and temporal distribution of lanceolate diagonally flaked points in eastern Siberia. The absence of detailed descriptions of these finds however precludes for the present comparisons of the Siberian points with the Kayuk series.

Kayuk site implements of antler and bone, as well as some forms of stone scrapers and blades show a considerable number of resemblances to the Ipiutak assemblage. Antler arrowheads, flint hammer heads, adz heads, fish spear center prongs, fish spear barbs, crescentic side scrapers, discoidal scrapers, and inset side and end blades are much alike in both collections. Ipiutak, however, lacks burins, microblades, and the large Kayuk points. In addition, the series of large angular blades from the Kayuk site is apparently absent in the Ipiutak collection (Larsen and Rainey 1948: 91–110). Resemblances to utilitarian objects like flint hammer heads, adz heads, fish spear barbs, and fish spear center prongs are probably not of great value as indicators of specific relationships since these general types occur in various chronological and cultural positions in the American north (Giddings 1952; Larsen and Rainey 1948; Murdoch 1892: 168). I think, however, that arrowhead, crescentic scraper, and inset blade resemblances may possibly relate the Kayuk complex more directly to Ipiutak with the strong probability that the former material is earlier.

Most Kayuk artifacts having Ipiutak characteristics were found in the two previously mentioned small sections of Areas III and IV, and were especially common among those implements recovered from Feature 4. There is, I think, a fairly good possibility that those implements, so much akin to Ipiutak in form, are intrusive among the remains of an older culture. On the other hand, the stratigraphy of the Kayuk site strongly suggests homogeneity. Even in the two areas in which artifacts resembling Ipiutak types most often occurred, typical Kayuk projectile points were found in essentially direct association. Nor did I find evidence for a mixing of the remains of two different cultures, either by natural phenomena such as solifluction, or by human activity. Therefore, until further evidence is available, I prefer to consider all, or nearly all, of the implications from the Kayuk site as being representative of one archaeological complex.

The impression that the Kayuk complex is not contemporaneous with the more early Arctic cultures is reinforced by the presence in the collection of a harpoon head with open shaft socket, and the other excellently preserved artifacts of antler and bone. However, the few burins, the two microblades, the larger prismatic blades, the fragment of a fluted point, and the series of lanceolate points suggest considerable time depth or at least a sharing of the complex with old traditions. Because of these two somewhat opposing bodies of evidence I am at present inclined to consider the Kayuk complex as belonging somewhere in time between the Denbigh Flint complex and Ipiutak. Further typological analysis, as well as the forthcoming radiocarbon dates, will be of considerable additional value in correctly placing the Kayuk complex in the Arctic chronology. Meanwhile, it represents a rather enigmatic addition to our knowledge of the prehistory of the northern regions.

Acknowledgments. These studies were supported by a contract between the Office of Naval Research, Department of the Navy, and the Arctic Institute of North America. The Department of Anthropology and the Peabody Museum of Natural History, Yale University, also contributed financial assistance.

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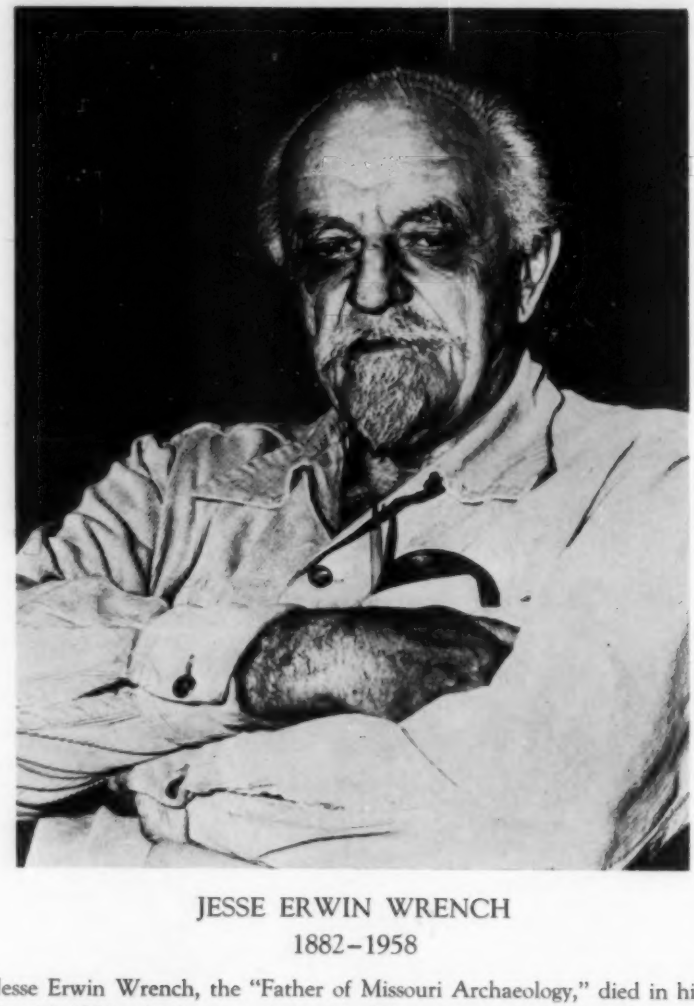
YALE UNIVERSITY
New Haven, Conn.
May, 1958



JESSE ERWIN WRENCH
1882–1958

Jesse Erwin Wrench, the "Father of Missouri Archaeology," died in his sleep October 14, 1958 at his home in Columbia, Missouri, just two days after he had been re-elected president of the Missouri Archaeological Society for the 25th consecutive year. "Prof" Wrench had an all-consuming desire that the prehistoric story of Missouri should not be lost, and he worked consistently toward that end until his death.

Born in North Afton, New York, September 10, 1882, he was the son of Marquis de Lafayette and Sara Minor Wrench. He was a descendant of a Hopkins who came over on the Mayflower and of Stephen Hopkins, a signer of the Declaration of Independence. On February 26, 1906 he married Jane Shurter. Surviving are Mrs. Wrench, two sisters, two brothers, and a daughter, Mrs. W. H. Heller of Columbia, Missouri.

(Continued on next page)

After receiving an A.B. degree from Cornell University in 1903 he did field work for the American School for Oriental Study and Research in Palestine, May, 1904 through August, 1905, together with two other students, Albert Ten Eyck Olmstead and Benson Brush Charles. Nathanial Schmidt, director of the school and their former teacher at Cornell, reported that their special preparation "included Latin, Greek, and Semitic epigraphy as well as Arabic, Hebrew, and Aramaic, the topography of Syria as well as the history of Western Asia, and also photography, squeeze-taking, and surveying." Apparently this was pioneer work in this area; the party was armed and really had a rough time of it. Schmidt writes:

> From Ba'albek they went up the Orontes valley to 'Ain Lebweh. Here they found themselves in a Metawileh town and were obliged to make their escape at three o'clock in the morning. A little north of Ras Ba'albek an attempt was made to rob them, and shots were fired, but no serious damage was done. From Homs (Emesa) they hoped to proceed to Palmyra, but orders came from the Wali of Damascus prohibiting the excursion, as the region was not considered safe. After a short visit to Hamah, they returned to Homs, walking the first day 29¾ miles. Next they went south through the plain of Homs, carefully examining the lake and the many mounds in this district. From Hermil they proceeded to Wadi Brissa to secure squeezes of the famous cuneiform inscription. After two days' work under peculiar difficulties — they had to carry water over a mile, were forced to use swing-ropes, and could secure no food — their supply of squeeze paper ran out and they were not able to finish the inscription. During the two days 150 sheets had been put on. From Hermil they went over the Hermil pass, nearly ten thousand feet high, to the Cedars, and having visited Hasrun, Tannurin, 'Akura, 'Afka, and Mezra'at, they reached Beirut by way of Nahr el-Kelb. As their photographic supplies had failed them, Mr. Wrench returned on a four days' trip and secured a good collection of photographs.

He returned to the Near East with a Cornell expedition to Assyria and Babylonia in 1907–08. A member of Phi Beta Kappa, he had been an instructor at Syracuse University before he joined the faculty of the University of Missouri in 1911. He became a full professor of history in 1930, professor emeritus in 1953 when he retired after 42 years of teaching service at Missouri. Upon his retirement the Missouri Legislature passed a resolution citing Professor Wrench as "a symbol of the University itself."

"Prof" Wrench was the most colorful member of the University of Missouri faculty and certainly the one best known to most students. His Vandyke beard, his flowing hair, his knickers, and his beret were known to everyone. In his earlier years he wore a cape and rode a bicycle. As Clarence Cannon recently wrote to me: "Prof Wrench was a very colorful figure, and it contributed much to the effectiveness of his life work." He was, indeed, a highly stimulating and effective classroom teacher and an efficient organizer.

He was prominent in activities both on and off the campus. He was an unofficial advisor to students long before the days of counseling and he and Mrs. Wrench were the "Missouri parents" of all the foreign students who attended the University. He sponsored the Tiger Claws pep squad and founded the "Wrench Wranglers" which became the basis for the "Thundering Thousand." Four student cooperative houses on the Missouri campus today are due in great part to his efforts. He was one of the principal organizers of several cooperative business enterprises in which fellow faculty members and Columbia citizens participated. For 20 years he guarded the door during registration at the University. From the beginning he oversaw student elections and chaperoned dances. He kept strict discipline, but some of us who were students in that day recognized the need for some faculty supervision at student gatherings and came to consider him as more of a silent ally rather than as a stern disciplinarian. There were also times when he took the student side in difficulties with the University administration.

In 1930, he conducted excavations of Indian sites along the Sac River, a branch of the Osage River. In the early thirties he helped carry out archaeological investigations in both Boone and Wayne counties in Missouri and also started the Archaeological Survey of Missouri in which he continued to be active until his death. Since he was teaching history, all of his archaeological effort was purely extra-curricular.

On December 11, 1934, he called a meeting of about a dozen persons from all over the state and with the help of J. Brewton Berry founded the Missouri Archaeological Society. We met in old Switzler Hall on the University of Missouri campus and he presented us with a set of objectives and suggestions for a constitution and by-laws for the new organization. We adopted these practically as he presented them and they have served the Society almost without change to the present time. I remember thinking at the time that "Prof" had obviously already spent a great deal of effort, thought, and energy in their preparation. The objectives of the Society, as stated at that first meeting, were to preserve the remains of the prehistoric people of Missouri,

to study these remains scientifically, to publish information about them, to provide both amateur and professional archaeologists with opportunities to discuss their common interests, and to arouse public opinion to an appreciation of the prehistoric past. Another objective, and a primary one, though it was not stated in the written goals of the Society, was to get an archaeologist on the staff at the University of Missouri.

One summer afternoon in 1935 "Prof" and several students came into my office in Marshall. He had been studying the records of the Lewis and Clark expedition and had determined approximately the location on the north bank of the Missouri where the explorers had spent the night. The records stated that at night the lights of the villages of the Missouri and the Little Osage had been plainly visible across the river about three miles from the Lewis and Clark camp and about three miles from each other. "Prof" requested a plat map and asked me if there were village sites within a certain arc along the river. I told him that there were two large and prominent ones, named the landowners, and explained how to get to them. How I wished that I had been free at the moment to go with them and to participate in the first work by which the prehistoric past of the once powerful Missouri and the Little Osage was being worked out.

No one was more active at University and Society excavations than "Prof." A picture that some of us will always carry is that of "Prof" back in the active days at Graham Cave, working all day long in clouds of dust, operating the power sifter, keeping the sacks of materials straight, and hollering every now and then both because he liked hollering and because he knew that it helped to keep everything moving. He was a man in motion. He did not like to write, and he wrote little, but he did a great deal of translating. He authored one book, *The March of Civilization* (1931), and co-authored another, *American Citizenship Practice* (1926). He also published in the *Missouri Archaeologist*: Archaeological Investigations in Boone County, Missouri (1938, Vol. 4, No. 3, with Berry, Chapman, and Seitz); Early Investigations in Northeast Missouri (1939, Vol. 5, No. 1); The Archaeology of Wayne County (1940, Vol. 6, No. 1, with Berry and Chapman); and a foreword (1951, Vol. 13, No. 2).

"Prof" lived to see the Missouri Archaeological Society become the largest organization of its kind in this country with a membership of more than 1400 in recent years. The University of Missouri obtained an archaeologist for its staff soon after the founding of the Society and Carl H. Chapman has long been Director of Archaeology at the University. In 1958 the *Missouri Archaeologist* reached its 24th year of publication. After retirement "Prof" again took up the archaeological survey as his particular and personal assignment and worked at it almost daily. Through the years many people had cooperated in this work. At his death, 82 of the 114 counties in the state were represented in the survey and a total of 5006 Missouri sites had been recorded on the permanent forms that had been provided for that purpose more than 26 years before. In addition, there were records on 1821 sites that were yet to be verified. This important body of data is in itself an impressive monument to his energy and influence in Missouri archaeology.

In 1952 the Missouri Archaeological Society presented him its "Honors Award" with the following citation:

> Be it known to all to whom these presents come that Jesse E. Wrench is hereby honored for his meritorious deeds in the furtherance of the aims, objectives, and ideals of the Missouri Archaeological Society, for his twenty years of unstinted diligence in guiding and leading the Society as its President, and for vigorous devotion to the advancement of scientific archaeology in Missouri.
>
> In the name of the Society this certificate is awarded and Jesse E. Wrench is designated the "Father of Missouri Archaeology" and his name is inscribed on the Achievement Plaque displayed in the Museum of Anthropology of the University of Missouri.

On October 12, 1958, just two days before his death, the Society presented a resolution at its annual meeting expressing again its appreciation to both Prof. and Mrs. Wrench for their support of the "archaeological movement" in Missouri. A memorial held on the University of Missouri campus, November 2, 1958 was attended by students, faculty, townspeople, and friends from all over the state. At this gathering 11 people gave tributes to Jesse E. Wrench for his active participation in 11 organizations and institutions. Missouri will long remember him. Archaeology particularly will give lasting gratitude to him for contributing so much.

HENRY W. HAMILTON

FACTS AND COMMENTS

A MISSISSIPPIAN HEADDRESS FROM ETOWAH, GEORGIA

Abstract

The small embossed ornaments of sheet copper found in Southeastern sites have usually been identified as "pendants" or "symbol badges," and have been considered part of the ritual equipment of the Southern Cult. Four graves of the Wilbanks period at Etowah contained such objects. They had apparently been mounted with feathers and slender wooden rods to form elaborate headdresses. Observers from the 16th century onwards describe "crowns" worn by the Coosa, Creek, and Natchez nobility that would have been very similar.

THERE ARE SEVERAL reported instances of small, embossed, sheet-copper ornaments found at Mississippian sites in the Southeast. Almost without exception, they are classified in most sources as pendants (Webb and DeJarnette 1942: 297; Willoughby 1932: 42). Waring and Holder (1945: 9) refer to these copper artifacts as "symbol badges" and include them, along with other exotic material, as a part of the Southeastern ceremonial complex or Southern Cult. They define symbol badges as ritual objects "pierced for suspension." Aside from this statement, there is an absence of speculation in the literature regarding the actual function of these symbol badges.

Recent excavations in Mound C at the Etowah site in Georgia (Kelly and Larson 1957: 39–48) have brought to light new data on the copper symbol badges which indicate that they were parts of headdresses. At Mound C they have been found in four graves which belong with the last construction phase of the mound. This phase dates from the Wilbanks ceramic period (Sears 1952: 106). The Etowah symbol badges were associated in graves with other ritual material belonging to the Southern Cult, supporting Waring and Holder in their assertion that they are ceremonial objects.

Types of Symbol Badges

In their original classification, Waring and Holder (1945: 9) recognized three types of symbol badges: baton, bilobed arrow, and arrowhead. At Mound C we have found a somewhat different list. The bilobed arrow type has not been encountered; and two, and possibly three, new types have been found. On the basis of the Mound C material, it is perhaps advisable to divide the baton type into two subtypes: terraced baton (Fig. 1 *a*, *b*) and cycloid baton (Fig. 1 *c*). Both batons are approximately the same size, both have a knob on the top, and both have a cross embossed on the surface. The terraced type has, in addition, an embossed line paralleling the top edge of the object, and a series of sharply angular indentations, or terraces, along both sides.

The arrowhead type of symbol badge from Etowah (Fig. 1 *d*) is somewhat at variance from the type found by Moore on sites along the Alabama River (Moore 1900: 289–347). All of the Alabama River symbol badges are rather crudely executed, being wide and rather blunt (Moore 1900, Figs. 49, 66, 67). The arrowhead symbol badges which Moore found at Moundville (Moore 1905, Fig. 104) more closely approximate the Etowah types. It should be noted that all of the Alabama arrowhead types are embossed with what appears to be a portion of an eye design. The Etowah types have only a single line embossed on the long axis of the object. One Etowah specimen is unique in that one barb of the arrowhead has been terraced.

The plume symbol badge (Fig. 1 *g*) was not listed by Waring and Holder, but it has been found at Etowah in circumstances that are identical to those of the arrowhead and baton types and should undoubtedly be included in the same category. This type is the same size as the others and resembles a flame or feather in outline. An embossed center line follows the undulations of the edges. It is perforated at the base. This symbol badge type does not appear elsewhere in the Southeast, although, examples of the sheet-copper plume hair ornament appear at Spiro (Hamilton 1952, Pls. 75, 77), as well as at Etowah (Willoughby 1932, Fig. 19).

A second type of symbol badge not listed by Waring and Holder is the eagle. Actually, two different copper ornaments are involved, but they appear to have been used in conjunction with one another. One ornament represents the head of the eagle (Fig. 1 *f*), and the other,

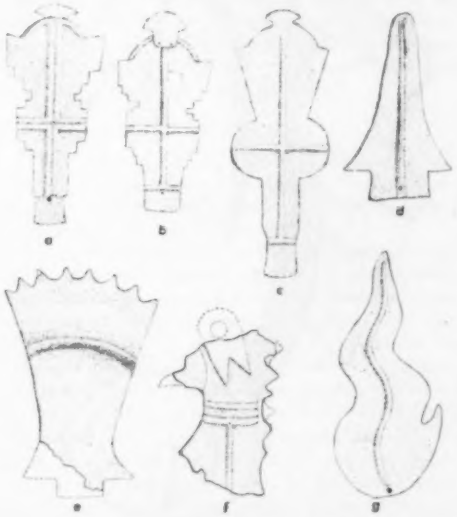


Fig. 1 [Larson]. Types of embossed sheet-copper badges from Mound C. *a*, *b*, terraced baton; *c*, cycloid baton; *d*, arrowhead; *e*, eagle tail; *f*, eagle head; *g*, plume. Length of *c*, 4⅛ inches.

the tail (Fig. 1 *e*). Details such as the eye are indicated by embossing. These symbol badges are the same size as the others and were found under similar conditions. A third possible symbol-badge type found in Mound C is a grotesque or feline head represented in a frontal view. Unfortunately, the single example recovered is too fragmentary to establish as a definite type.

HEADDRESS TYPE

In all but one instance, the sheet-copper symbol badges found in Mound C were associated directly with the skulls of the individuals in the graves. In most cases, there were from eight to 12 symbol badges found with a series of narrow cedar (?) rods. These rods were of varying lengths; the longest recovered were 8¼ inches in length. In some cases, the rods were stained with red ocher. Generally the rods gave the impression of having been bound together at one end so that a fan-like arrangement resulted. A piece of leather, to which the ends of the rods seemed to have been fastened, was found lying over the forehead of one skull.

While our data are not as complete as could be desired, it is felt that certain inferences can be drawn from them. We have a series of copper objects around, or over the skull, with numerous wooden rods that appear to be fastened to a leather cap or band on the skull. The suggestion is that we are dealing here with a rather elaborate headdress, one in which sheet-copper symbol badges were attached to a framework of narrow wooden rods fanning out from a leather cap or band worn on the head.

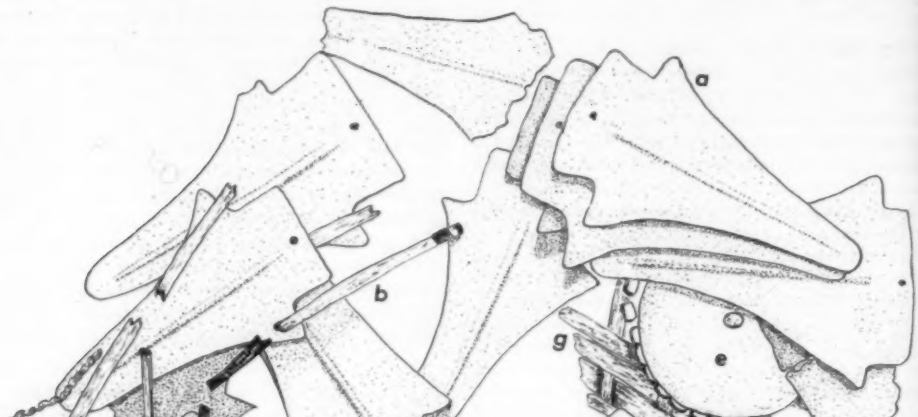


FIG. 2 [Larson]. Field drawing of symbol-badge headdress in situ with Skull 2, Burial 38. *a*, copper symbol badges; *b*, wooden rods; *c*, bird or mammal bones; *d*, conch shell beads; *e*, copper covered wooden ear discs; *f*, skull fragment; *g*, fragment of cane matting. Length of *a*, 3 inches.

FIG. 3 [Larson]. Restoration of the headdress found with Burial 67.

No two of these headdresses from Mound C were identical. Some contained a single type of symbol badge while others were made up of several types. A few of the copper badges retained the impressions of feathers, and it is thought that at least some of the headdresses were made with feathers attached to the framework. With some of the headdresses were found the foot bones of a small mammal or bird (Fig. 2), stained with red ocher. There may well have been an animal or bird skin included as a feature of these particular headdresses.

In the preparation of a museum exhibit for the Etowah site, an attempt was made to reproduce one of the symbol badge headdresses. This reproduction (Fig. 3) utilized, in so far as it was possible to determine, the arrangement and types of symbol badges which were part of a headdress found at the feet of Burial 67. The color of the feathers was of course conjectural, but fragments of a red feather robe were found in another burial so red feathers were used in the reproduction. The size and arrangement of the feathers on the framework were also guesswork, but, by trial and error, it was found that large wing or tail feathers were too rigid to be fastened effectively to the rods, and that they lacked the fluffiness necessary to cover the framework. Fastening the feathers directly to the rods seemed to be the logical arrangement. The symbol badges were simply tied to the rods by means of a hole in the base of each badge.

The symbol-badge headdresses found in other graves at Etowah must have closely resembled the one just described. The use of different types of symbol badges and, in some instances, animal or bird skins, means that some variation existed, but the general type was probably the same. There have been other headdress types found at Etowah which are quite different from the one under discussion. In all probability, the various types carried implications of ritual and/or social distinction.

DISCUSSION

While there are no detailed early descriptions of this type of headdress, certain 16th and 17th century narratives and drawings indicate that such a headdress would not be alien to the Southeastern area.

The various narratives of the De Soto expedition mention headgear which suggest a type similar to that found at the Etowah site. Elvas describes the cacique of Coosa as wearing "a diadem of plumes" (Lewis 1907: 183). Garcilaso relates that the noblemen who accompanied the cacique of Coosa to his meeting with De Soto "wore great feather headdresses, these being the adornments of which the natives of this great kingdom are most proud" (Varner and Varner 1951: 343). The nobles who attended Tascalusa at a meeting with De Soto are also described as "well adorned with great feather headdresses" (Varner and Varner 1951: 349). According to Du Pratz (Swanton 1911: 106–7) the headdress of the Great Sun of the Natchez was a:

> crown . . . composed of a cap and a diadem, surmounted by large feathers. The cap is made of a netting, which holds the diadem, which is a texture 2 inches broad and presses together behind

tightly as is desired. The cap is of black threads, but the diadem is red and embellished with little beads or small white seeds, as hard as beads. The feathers which surmount the diadem are white. Those in front may be 8 inches long, and those behind 4 inches. These feathers are arranged in a curved line. At the end of these feathers is a tuft of hair . . . and above a little hairy tassel . . . all being only an inch and a half long and dyed a very beautiful red. This crown or feather hat is an object very pleasing to the sight.

This is apparently the type of headdress pictured in the Du Pratz drawing of the Great Sun (Swanton 1946, Pl. 75).

Adair describes (Williams 1930: 427) the "crowns" or headdresses presented to Creek warriors in some detail:

The crown is wrought round with the long feathers of a swan, at the lower end, where it surrounds his temples, and it is curiously weaved with a quantity of white down, to make it sit easy, and appear more beautiful. To this part that wreathes his brows, the skilful artist warps close together, a tinglet of the longest feathers of the swan, and turning them carefully upward, in an uniform position, he, in the exactest manner, ties them together with deer's sinews, so as the bandage will not appear to the sharpest eyes without handling it. It is a little open at the top and about fifteen inches high. The crowns they use in constituting war-leaders, are always worked with feathers of the tail of the cherubic eagle, which causes them to be three or four inches higher than the former.

Swanton (1946: 508), in remarking on the headdresses pictured by Le Moyne, states that with regard to one type:

we observe a headband showing a succession of short points as if it were a kind of crown [Lorant 1946: 59, 103]. This is all too suggestive of European crowns, and yet in later times, at all events, bands of this pattern, hammered out of silver, were much in use, I myself having seen one that belonged to an Alabama Indian living in Louisiana.

Swanton (1946: 510) adds that these same silver crowns were in all likelihood directly descended from similar copper headdresses made during the precontact period.

A comparison of the above descriptions and the Etowah headdresses will reveal several similarities. The general shape of the Etowah headdresses conforms to the diadem of feathers worn by the cacique of Coosa, and the feather crown worn by the Great Sun of the Natchez. If Swanton's supposition is correct, the use of the copper symbol badges in the Etowah headdresses seemingly finds its historic counterpart in the silver headbands worn by the Southeastern tribes.

Conclusions

For the most part, prehistoric headdresses from the Southeast are unknown. From the scant data accumulated in several ceremonial graves in Mound C at Etowah, we have attempted to restore a headdress which must have been a part of the elaborate costume of the Southern Cult. The degree to which this reconstruction proves successful is dependent upon the recovery of more data. Nevertheless, the general form of the Etowah headdress coincides in several respects with ethnographic descriptions of early historic headdresses in use in the Southeast.

Acknowledgments: I am indebted to the Georgia Historical Commission for permission to publish this manuscript and to Jack House for assistance in making the reproduction of the headdress.

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THE JAMES ALLEN SITE, NEAR LARAMIE, WYOMING

Abstract

A bison-kill site in Wyoming with a radiocarbon age of about 8000 years has yielded numerous points of a type formerly termed "Oblique Yuman." It is proposed that they now be named Allen points, after this site.

ONE OF THE LONG STANDING problems of paleo-Indian studies involves the context of certain relatively long, more or less parallel-sided, unstemmed, concave-based projectile points characterized by oblique, parallel flaking of unusual excellence. In the past these points have been referred to as Colorado, Yuma, Oblique Yuma, Yuma-Folsom, and Browns Valley points as well as by other names. The type has been recognized from the general area of the western Plains and the lower flanks of the Rocky Mountains from New Mexico to Alberta. Relatively great antiquity has been assumed with little real evidence and these points were considered to be a subtype of the Yuma category before this term became obsolete. Hitherto they have been known from surface finds

without context, or as unusual specimens in sites characterized principally by other types of points. The James Allen site, near Laramie, Wyoming, is a type site for these points. Here, they occur in association with other tools, the bones of *Bison occidentalis* or *Bison antiquus*, and a radiocarbon date of 7900±400 years B.P. (M–304). It is therefore proposed that one of the varieties of this projectile point type be named the Allen point in honor of James Allen of Cody, Wyoming, who discovered the site.

E. B. Renaud (1931) first vaguely recognized this point type, at least as far as its shape was concerned, and called it Colorado point, Type 2A, Base B2. In 1932 he renamed it Yuma point, Type 2A, B2 (Renaud 1932). He does not appear to have recognized that the distinctive oblique parallel flaking is associated with this shape specifically, though he did describe oblique flaking as one of the general characteristics of his Yuma category. Thereafter this point type became immersed in the general Yuma category. The various definitions of Yuma points made since then have been broad enough to include the type described in this paper without considering it to be a distinctive form (for example, Jenks 1937: 36).

H. M. Wormington and Betty Holmes first recognized the association of oblique, parallel flaking with specific shapes when they pointed out that the Yuma points included at least three distinctive flaking techniques and that two of these were almost invariably associated with certain shapes (Wormington 1939: 22–6). The terms, oblique, collateral, and indeterminate, were applied to these techniques. The insight behind this analysis became apparent later as further research defined the Eden and related Scottsbluff types as associated with a particular complex and the collateral technique, and the San Jon and Plainview types as associated with certain indeterminate varieties. The third technique, oblique, appears on points of characteristic shapes which have remained until now with little context and without evidence of an antiquity comparable to that of the Eden, Scottsbluff, San Jon, and Plainview types. When Wormington (1948) proposed that the term Yuma be considered obsolete and the various varieties known be given individual names as their cultural distinctiveness warranted, she suggested that the oblique, parallel flaked points be left unnamed and simply referred to as "points with oblique, parallel flaking" until a type site could be discovered. It is proposed that the James Allen site be accepted as the type site for the variety of oblique, parallel flaked points described here and that the point type be named Allen point. It is to be noted that this designation refers to only one of the characteristic shapes of the oblique, parallel flaked points in the old Yuma category.

Until the excavation of the James Allen site, Allen points had rarely been found under circumstances which even vaguely suggest antiquity. One dubious Allen point was found near Cumro, Nebraska, in doubtful association with the bones of extinct bison (Schultz 1932). A few obliquely flaked points were found at the Lindenmeier site above the lowest level in which Folsom points occurred and below a level which produced a few fragments of points with horizontal parallel flaking which are presumably Eden points (Roberts 1940). It is not clear, however, whether these Lindenmeier specimens can be called Allen points. Two of the five points found with a skeleton in Browns Valley, Minnesota, in 1934 may be related to the Allen points, but differ somewhat from them (Jenks 1937). The Browns Valley specimens have the characteristic oblique, parallel flaking, but also a greater proportional breadth. They occur far outside the range of distribution now known for Allen points. Roberts (1940) suggested that they be called Browns Valley points. This name has also been occasionally applied to points which belong in the Allen category. Points from Hot Springs focus at Angostura Reservoir in western South Dakota which have been called Long points (Hughes 1949) may also be related to Allen points. They seem to differ in that the characteristic oblique, parallel flaking appears on only a few specimens and also in shape, especially the base. Long points seem to be more like the Agate Basin points found between Newcastle and Lusk in northeastern Wyoming (Roberts 1940).

The James Allen site lies just off the northeastern flank of Boulder Ridge, a low, northeast-southwest trending mountain uplift which forms part of the southern boundary of the Laramie Basin, and about 14 miles almost directly south of Laramie (T13N, R74W, S1, SE¼). About three-quarters of a mile to the west of the site is Sportsman Lake, a small, shallow, and sometimes dry lagoon. The localities about several of the large permanent springs in the vicinity have been tested sporadically, but to date no Allen points have been found in them, though evidence of prehistoric occupation is plentiful. The immediate area of the site is open country, scantily covered with grass and sagebrush, and sloping slightly toward the north at about the point where the flank of Boulder Ridge might be said to join the plain. Several hundred feet to the south is a minor ridge (almost an escarpment) oriented roughly southeast to northwest which produces a sharp increase in elevation of about 50 feet beyond which the terrain slopes gradually upward toward Boulder Ridge. This is not to say that the site lies at the base of a cliff, but rather at the foot of an area where the slope is greater than usual so that the site is masked from view from farther up the hill. Since the site is not a camping place, but essentially a buffalo-butchering site, this topography might account for the material being found where it was. The area could have served as a kind of trap; the bison could have been driven northward over the ridge into some kind of enclosure or human surround. No evidence of any sort of enclosure was found but the bison appear to have been killed close to each other in the restricted area in which their remains were discovered. It would have been difficult to drag the carcasses very far and there would have been no point in assembling them for butchering.

The evidence of human activity was recovered from an irregular area which was enclosed within a 50-foot square. It consists of stone artifacts and chips scattered among the disarticulated bones of the slaughtered bison.

The surface on which the material was found consisted of Permian Satanka shale and the covering deposit was principally windblown material, decomposed elements of the shale formation, and contained a small amount of humus. A small part of the southern section of the bone-bearing area was eroded by one of the several large blow-outs which deface the slope. The resulting exposed profile made possible the discovery by Allen of the bones and the first projectile point, for the site was otherwise completely covered. Excavation began with a single row of 5-foot squares which was later expanded by 5-foot square sections to include a 40-foot square which appeared to expose practically all of the occupied area of the site. Work proceeded from the surface down in each 5-foot square to expose the bones and artifacts in place. All material was screened.

Bones of buffalo (*Bison occidentalis* or *Bison antiquus*) only were recovered. Many were completely disarticulated, but frequently whole or partial legs and vertebral columns were articulated. Skulls were represented by small pieces only. About 15 animals could be identified. They were probably all killed in a single hunt. The impression given by the debris is that the animals were killed in a group close to where their remains were found. A quick butchering job probably involved stripping the flesh from the bones with minimum disarticulation; wolves and coyotes probably completed the scattering of the bones. The presence of some plano-convex scrapers suggests that at least preliminary work on the hides was done at the kill site. There was no evidence of fire or other camping activity except for the very few partly charred bison bones from which the radiocarbon date was obtained.

Among the stone artifacts from the site are 30 more or less fragmentary Allen points ranging from substantially complete specimens to tiny fragments (Fig. 1 *a–p*). There are eight proximal and seven distal ends; the rest are fragments of the midsection. Materials are: 23 fine-grained, red, brown, yellow, gray, or buff quartzite; two light yellow brecciated quartzite; two multicolored jasper or jasp-agate; one agate; and one metamorphosed silt-stone. A thick, tough, reddish deposit of lime had collected on the under surfaces of many specimens. These Allen points demonstrate an extremely narrow range of variation in shape and flaking technique. The shape is lanceolate without notches. The edges incurve to a rather rounded point, tend to be parallel at the midsection, and very slightly incurve toward the base, sometimes expanding to a suggestion of a fishtail base. This occasionally produces a scarcely perceptible constriction of the proximal third of the point which is frequently slightly more apparent on one side than the other. This constriction seems to be more a function of the smooth grinding of the proximal third of the edges than of a contour deliberately produced by pressure flaking.

Bases have rounded corners and are indented to a distance usually about one-quarter of the basal width. Central thinning of the base was accomplished by the removal of one or more longitudinal flakes and usually extended about one-half the width of the base. The basal concavity was ground smooth. Cross sections are uniformly lenticular with thin, sharp, and regular edges. There is a tendency for small chips to break off the edges on the distal third of the point (Fig. 1 *a–d*). I have seen this feature so frequently on points in private collections as well as on the points from the Allen site that I regard it as one of the major characteristics of Allen points.

The most distinctive feature of these points is the excellent oblique, parallel flaking. The uniformity of the flaking and the length of the flakes both reflect a skill in pressure flaking far out of the ordinary. The flake scars cross the surface of the blade at an angle which varies from transverse to about 60° with the longitudinal. Apparently the technique was to drive from one edge a flake which usually extended about two-thirds of the distance across the point. Then the point was reversed and a flake driven from the proper place on the opposite edge so that the resulting scar would be continuous with the longer one. The successful result gives the appearance of a single, continuous flake scar extending from one edge of the point to the other, although close examination usually reveals the juncture. Repetition of this process covered the surface of the point with a series of regular, oblique, parallel flake scars. Although an aesthetic result was achieved, the obliquity of the flake scars is probably due to the configuration of the human hand rather than to an effort to produce something aesthetically pleasing. Experimentation has shown that the point securely held transversely against the heel of the hand by the pressure of the fingers is in a position which presents the edge of the blade to the flaker at an angle which would produce flaking of the oblique kind on the Allen points. There is little or no edge retouch.

The fragment of what appears to be the largest point is too incomplete for measurement, but if it were of the same proportion as the other points it would have been about 4.5 inches long. Its width is 1.1 inches, thickness 0.19 inch (Fig. 1 *g*). I have seen several equally large points of this type in private collections in the region. The smallest point in what seems to be the normal range of size variation is 3.25 inches long, 1.01 inches wide, and 0.22 inch thick (Fig. 1 *b*). The other small point (Fig. 1 *h*) is so small as to fall outside the range of variation established by the other points, though it resembles the rest of the points in all other features. It is 0.6 inch wide, 0.1 inch thick, and was probably about 1.6 inches long. The one agate point (Fig. 1 *a*) apparently broke during the hunt into three transverse sections which fell with opposite sides up. The exposed sides of the three sections became heavily patinated, so that when the pieces were properly fitted back together, there was a marked color contrast between them. This suggests that the debris from the hunt was exposed on the surface for a considerable time before being covered. A resharpened point (Fig. 1 *b*) was found by Allen on the surface of the blowout immediately south of the site before the excavation was begun. The midsection of another transversely broken point (Fig. 2 *c*) was found in place under the bison bones;

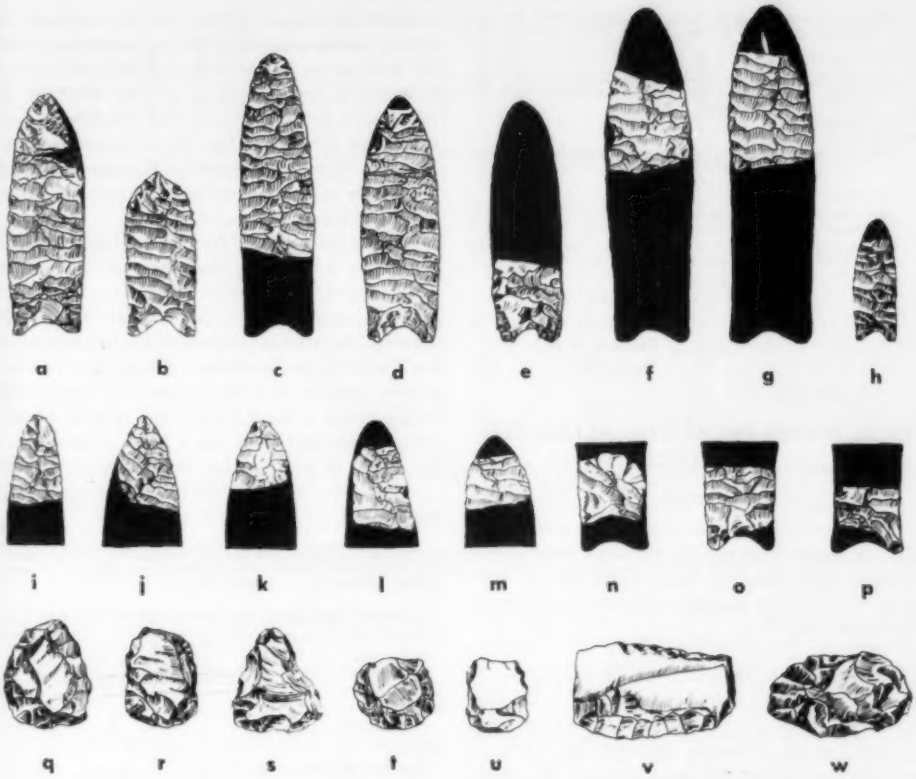

FIG. 1 [Mulloy]. Artifacts from the James Allen site, near Laramie, Wyoming. *a–p*, Allen points; *q–u*, plano-convex scrapers; *v*, *w*, scrapers or knives. Length of *a*, approximately 3 inches.

the distal section was found on the surface about 100 yards east of the site. All of the other fragments illustrated were in place among the bones; only six fragments of the entire collection were surface finds in the vicinity of the site.

The six whole plano-convex scrapers (Fig. 1 *q–u*) were made of the following materials: three agate, two jasper, and one fossil wood. Shape does not appear to be very consistent and varies from triangular through ovoid and pyriform to subrectangular. All are made from flakes with the cutting edge opposite the striking platform. There are no notches or hafting arrangements. As a whole they are cruder than those from later sites, but individual specimens are indistinguishable from many later examples. Length ranges from 0.95 to 1.5 inches, width from 0.75 to 1.2 inches, thickness from 0.22 to 0.4 inch. There are two knives or scrapers. One (Fig. 1 *v*) is of brown quartzite, is made on a rectangular lamellar flake of vaguely trapezoidal cross section, and has unilateral pressure flaking on the convex side of its parallel edges. It is 2.15 inches long, 1.3 inches wide, and 0.3 inch thick. The other (Fig. 1 *w*) is of buff quartzite, is made from an ovoid core, is bilaterally percussion flaked, and has irregular sharp edges. It is 1.9 inches long, 1.1 inches wide, and 0.4 inch thick. There are also 60 unretouched flakes and cores most of which are under 1 inch in diameter. Practically all appear to be waste from percussion flaking. Materials are: 46 quartzite, nine jasper or jasp-agate, and five agate.

Acknowledgments. I wish to extend my most sincere thanks to James Allen of Cody, Wyoming, who first called my attention to the site in the autumn of 1949. Allen has been a student of early man for a long time and has made a number of other valuable discoveries including the Horner site, near Cody, which is the type site for the Eden complex. Appreciation is also extended to James B. Griffin, Museum of Anthropology, University of Michigan, for his assistance in obtaining the radiocarbon date; to Paul McGrew and Jack E. Berman, Department of Geology, University of Wyoming, for studying and reporting on the bone material; and to the students in my archaeological field classes in 1951, 1953, and 1954 for doing the excavating.

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BISON BONES FROM THE ALLEN SITE, WYOMING

Abstract

Measurements of bison metapodials give promise of a basis for species identification, but more data will be needed for fully satisfactory results. Bones from the Allen site in Wyoming are probably either *Bison occidentalis* or *Bison antiquus*.

FOSSIL BISON METAPODIALS may be used for species identification because they are resistant to weathering. The method is applied here to bones from the James Allen site, near Laramie, Wyoming. However, the results are somewhat inconclusive and more data will be needed before the method can be made effective.

Accurate measurements could be obtained from only 16 of some 30 bison metapodials from the Allen site. The remainder were either too badly weathered to measure or possessed the unfused caps of immature animals. Measurements were taken in millimeters and sex was based on relativeness, heaviness and length. The sex of the measured specimens is: metacarpals, eight female, one male; metatarsals, six female, one male. Sex determination was difficult because of the limited number of specimens. Although some of the smaller specimens may be misrepresented, the two male metapodials are by far the largest ones in the collection. It is interesting to note that there was a high percentage of female and immature bones at the Finley site, near Eden, Wyoming (Schultz and Frankforter 1951: 122).

Table 1 indicates that metacarpals of *Bison bison*, the recent Plains species, rarely exceed 210 mm. in length, but that those of *B. occidentalis* and *B. antiquus*, very late Pleistocene and sub-Recent contemporaries (Skinner and Kaisen 1947: 156), are always more than 200 mm. long. The bison metapodials from the Allen site correspond more closely with the early species. The ratio analyses shown graphically in Figure 1 are based on the method explained by Simpson (1941: 23–5). In the comparison of male metacarpals the Allen site specimen is roughly the same size as *B. athabascae* and midway between *B. bison* and *B. antiquus* (Fig. 1 *a*). The Allen site male metatarsal is larger, in general, than *B. athabascae*, again lies midway between *B. bison* and *B. antiquus*, but seems to possess the same proportions as *B. antiquus* (Fig. 1 *b*). The female metacarpals are nearly in proportion to, but larger than those of *B. bison* (Fig. 1 *c*).

The specimen count of female metacarpals in terms of size groups indicates that the Allen site bison resemble most closely *B. occidentalis* or *B. antiquus*. The ratio diagram comparisons are not as conclusive, but they also show that the Allen site bison have affinities with the very late Pleistocene and sub-Recent species. It is interesting to note, however, that the comparison of female metacarpals, which is based on the only sizeable sample of Allen site specimens, indicates a *B. bison* correlation. In the absence of more detailed information, it can be concluded that the bison from the James Allen site are probably either *B. occidentalis* or *B. antiquus*.

Acknowledgments. I am indebted to Paul McGrew, Department of Geology, University of Wyoming, for supervision of this research, and to Morris F. Skinner, Frick Laboratory, American Museum of Natural History, for comparative material.

Table 1. Specimen Count of Female Bison Metacarpals*

Provenience and Species	Greatest Over-all Length in 10-Millimeter Size Groups				
	180–90	*190–200*	*200–10*	*210–20*	*220–3*
Montana					
Bison bison	7	40	21	2	
Eden					
Bison occidentalis				1	
Scottsbluff					
Bison occidentalis			7	5	4
Lipscomb					
B. (Simobison) antiquus			5	28	15
A. M. N. H. Expedition to Montana, 1887					
Bison bison		10	10		
Folsom, A. M. N. H. Composite Mount					
B. (Simobison) antiquus				1	
James Allen site			4	4	1

* After Schultz and Frankforter (1951) with modifications and additions.

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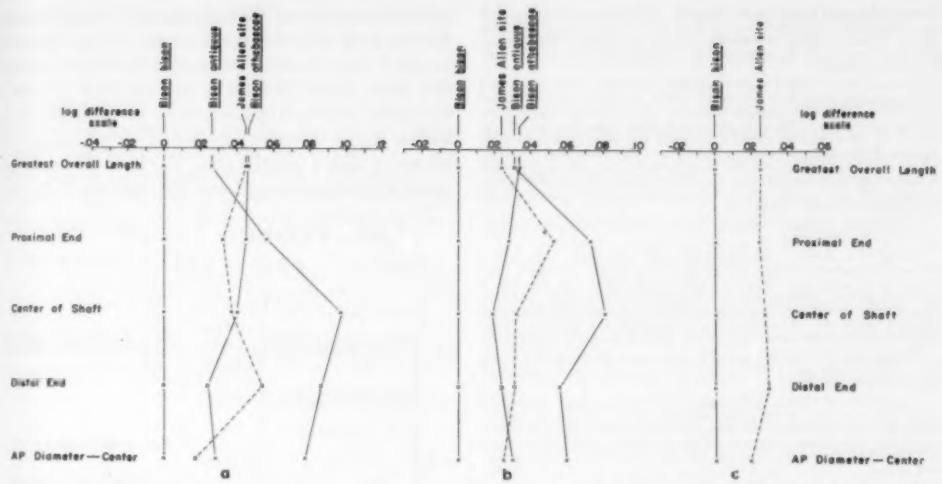

FIG. 1 [Berman]. Ratio diagrams of five measurements of bison metapodials using *Bison bison* as the standard of comparison. *a*, male metacarpals, 23 *B.* bison, one *B. antiquus* of undetermined sex from American Museum of Natural History composite mount, one *B. athabascae*, one Allen site bison; *b*, male metatarsals, 19 *B. bison*, one *B. antiquus* (same specimen as in *a*), one *B. athabascae*, one Allen site bison; *c*, female metacarpals, 18 *B. bison*, eight Allen site bison.

ANCIENT MESOAMERICAN MORTARS, PLASTERS, AND STUCCOS: LAS FLORES, TAMPICO

ABSTRACT

Chemical and microscopic examination of the material from successive floors of Mound A, Las Flores, Tampico, indicates that each building unit consisted of a lime-aggregate forming a monolithic mass, with subsequent plastering, essentially as at Comalcalco, Tabasco.

IN A PREVIOUS PAPER (Littmann 1957) it was shown that a repetitive building unit of lime-aggregate, wash coat, and plaster had been used in the construction of Temple IV at Comalcalco, Tabasco, and on the basis of the description by Ekholm (1944) it was suggested that a similar type of construction may have been employed in building Mound A at Las Flores, Tampico, Tamaulipas. A re-examination of Mound A at Las Flores was made to test this suggestion. A sequence of units consisting of lime-aggregate, plaster, and probably wash coat was established.

ON-SITE OBSERVATIONS AND SAMPLING

Mound A was devoid of trees but overgrown with grass and low, thorny bushes except for the upper part of the west face which had been very recently excavated. The exposed surface, about 2 m. high and 4 m. long, extended southward from the Northwestern Stairs. The top of the cut appeared to be at the same elevation as Floor B in Ekholm's (1944, Fig. 19) east-west profile of the mound and to have been made at a point east of Stairway VI. It is quite probable that the west face was a profile of the core of the upper portion of the mound. The general appearance of the exposed west face was that of an earthen bank containing white, horizontal bands. The north-south profile of the mound is shown in Figure 1 in which the odd-numbered and shaded bands represent the floors and the even-numbered and unshaded bands the fills. These same numbers have been assigned to the corresponding analytical samples. It should be noted that while the area above Floor 1 is shown as a fill, it may be no more than the accumulation of soil and debris on the floor surface since the excavation of the mound. It was also possible to expose Floor 12 by digging through this overburden at a point somewhat east of the edge of the cut, but the identity of this floor with Floor 1 was not established because it was not pertinent to the present investigation. While no serious effort was made to match the floors discussed here with those described by Ekholm (1944, Fig. 19), there is some evidence to suggest the following correlation: Sample 1 and Ekholm's Floor B; Sample 3, Floor (?); Sample 5, Z (extension); Sample 7, Y (extension); Sample 9, K (extension); Sample 12, Floor B–2. The criteria defined in the first paper of this series (Littmann 1957) are used to describe the analytical samples. Floors are considered plasters; fills are considered lime-aggregates when they contain lime. The laboratory procedures also follow those of the earlier paper. Identification of the acid-insoluble material was made by microscopic examination at 30 diameters. It appeared to be a mixture of clay and sand with the sand predominating in the floor samples.

Sample No. 1 (Floor). Plaster, 2.8 cm. thick, contained large amounts of small shell fragments but no carbon. The mass was hard and cohesive and separation of the lime from the shell could not be readily made prior to analysis. A very thin, yellowish, upper surface indicated the possible use of a wash coat, though the coat

was too thin and fragile to be removed. The plaster under the wash coat was white and appeared to have been laid from a very wet mix, a situation which would account for its apparent high density and the formation of an upper surface of somewhat finer texture than the mass proper.

Sample No. 2 (Fill). Lime-aggregate, 12.6 cm. thick, contained lime particles, some shell fragments, pieces of plaster (some painted red) but no carbon. The pieces of plaster were no larger than 1.5 cm. in any dimension. When in place and damp, the fill was yellow-brown in color and so crumbly it could not be removed in large pieces. When dry, the larger pieces were fairly hard and cohesive. Upon rewetting and drying the mass behaved like clay and yielded a strong aggregate undoubtedly capable of supporting an appreciable weight. Prior to analysis, the entire sample less any pieces of plaster was ground to assure uniformity.

Sample No. 3 (Floor). Plaster, 3.0 cm. thick, identical in appearance with Sample No. 1.

Sample No. 4 (Fill). Lime-aggregate, 35.0 cm. thick, contained a few visible particles of lime but no plaster or carbon. No shell fragments were observed. When in place and damp, the fill was a brownish yellow. When dry and powdered, it was much yellower than Sample No. 2. It was also crumbly when wet and hard and cohesive when dry. On rewetting it behaved like Sample No. 2. Prior to analysis the entire sample was ground to assure uniformity.

Sample No. 5 (Floor). Plaster, 2.0 cm. thick, identical in appearance with Sample No. 1 except that there appeared to be more shell in the upper portion.

Sample No. 6 (Fill). Lime-aggregate, 22.5 cm. thick, contained some lumps of lime, a few shell fragments but no plaster or carbon. When in place and damp, the fill was brown in color and gray-brown when dry. The other properties of the fill were similar to the samples described above. Prior to analysis the entire sample was ground and mixed.

Sample No. 7 (Floor). Plaster, 3.0 cm. thick, identical in description with the previous samples except that the upper surface (wash coat) appeared less yellow and smoother.

Sample No. 8 (Fill). Lime-aggregate, 25.4 cm. thick, identical with description of Sample No. 6, except that no lumps of lime were visible and it was reddish in color. The entire sample was also ground and mixed prior to analysis.

Sample No. 9 (Floor). Plaster, 2.5 cm. thick, identical in description with Sample No. 1, except that the wash coat was somewhat thicker though still too thin and fragile for separation. The shell also seemed to be somewhat more completely burned.

Sample No. 10 (Fill). Lime-aggregate, thickness not determined, contained carbon. The color of this fill was similar to that of Sample No. 8, but darker.

Sample No. 11. Plaster, 2.5 cm. thick. This sample was taken from a portion which was still in place on the lower surface of the fill corresponding with Sample No. 10. The sample appeared to contain less shell than the floors but no carbon. It also appeared to have been covered with a very thin and fragile wash coat.

Sample No. 12 (Floor). Plaster, 1.8 cm. thick and painted red. The red wash coat was removed by scraping but was too badly contaminated with plaster for analyses to be significant. It was, however, free of shell. The white portion of the floor was similar to the other floor samples except that it appeared somewhat softer.

Discussion

A review of Table 1 leaves little doubt that distinct building units were employed in the construction of the pyramids comprising Mound A. The relative uniformity of the composition of the lime-aggregate suggests either the transmission of a strong tradition over an extended period of time or successive constructions over a reasonably short period. The use of lime-aggregate to form a monolithic mass parallels exactly its use at Comalcalco, and Las Flores, therefore, represents a second instance of the use of such a building unit. The basic difference between the techniques at Comalcalco and Las Flores lies

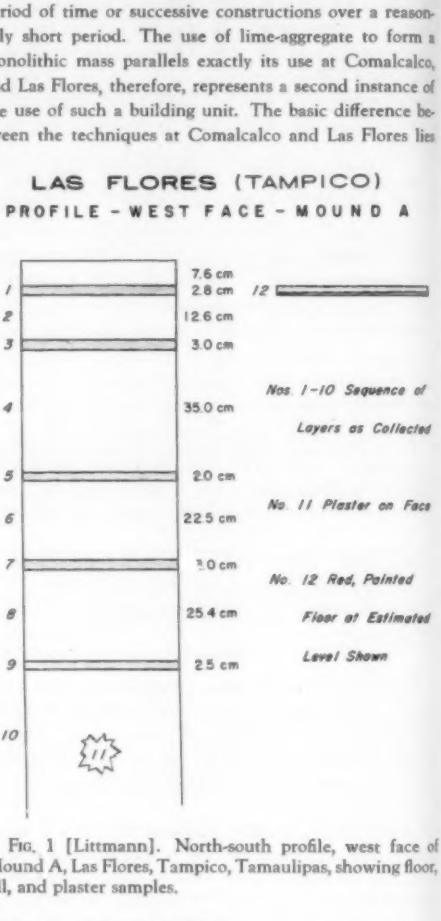

Fig. 1 [Littmann]. North-south profile, west face of Mound A, Las Flores, Tampico, Tamaulipas, showing floor, fill, and plaster samples.

Table 1. Analytical Results, Mound A, Las Flores, Tampico

Sample Number	Description	Per Cent Insoluble	Per Cent Ca	Per Cent Mg	Insoluble-free Basis: Per Cent Ca	Insoluble-free Basis: Per Cent Mg	Ca/Mg Molar Ratio
1	Floor, plaster	11.8	34.3	0.91	38.4	1.03	24.9
2	Fill, lime-aggregate	57.9	15.3	0.50	36.3	1.19	18.4
3	Floor, plaster	9.1	34.1	0.96	37.9	1.05	21.9
4	Fill, lime-aggregate	64.1	13.2	0.54	36.8	1.50	14.9
5	Floor, plaster	5.2	36.1	0.46	38.1	0.48	48.2
6	Fill, lime-aggregate	70.7	9.8	1.02	33.1	3.48	5.8
7	Floor, plaster	6.3	36.1	0.44	38.6	0.47	50.0
8	Fill, lime-aggregate	67.3	11.4	0.49	34.9	1.50	14.2
9	Floor, plaster	9.9	34.8	0.48	38.7	0.53	44.3
10	Fill, lime-aggregate	69.5	10.5	0.65	34.4	2.13	9.8
11	Plaster	7.9	35.5	0.45	37.5	0.49	46.4
12	Floor, plaster	9.5	34.5	0.61	38.6	0.68	34.5

in the absence of the use of a wash coat between the lime-aggregate and the plaster at the latter site. A second difference appears also to exist in Samples No. 6 and 10 (fills) in which the Ca/Mg ratio is appreciably lower than in all other samples. This suggests the use of a dolomitic limestone in combination with shell as a source of lime. Ekholm (1944) reports that the site is underlain with stone, but its composition is unknown. The analyses of the floors and the sample of wall plaster, however, are what would be expected from atypical shell-derived lime.

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Westfield, N. J.
November, 1957

COILED SHERDS FROM THE HIGH PLAINS

ABSTRACT

Several sherds from western Kansas, probably associated with Upper Republican or Woodland material, are from vessels made by coiling, in contrast to the "non-coiled" or "lump-modeled" technique usually considered characteristic of Plains pottery.

A COLLECTION OF SHERDS from a stratified site in western Kansas, sent in January, 1957, to the Division of Archeology, United States National Museum, for examination and report by Peter Bowman of Wallace, Kansas, contained a number of sherds belonging to one or more Woodland manifestations. Five of these showed clear evidence of the use of the coiling technique in vessel manufacture. Two more coiled sherds have since come to light from another site. Plains pottery has usually been described in the past as lump-modeled or as made by the paddle-and-anvil technique (compare Gifford 1928: 365).

The first sherds came from a site in Coal-oil Canyon, south of the Smoky Hill River, in Logan County, Kansas, some 35 miles east of the Kansas-Colorado state line. The site, although small and far from rich in pottery, has produced a pot and a few scattered sherds which may be assigned to the historic Pawnee, a sparse amount of Dismal River ware, and a relatively good yield of Upper Republican and Woodland sherds. A prepottery horizon appears to be present below the ceramic levels. The five coiled sherds from this site are from two pots. Two sherds (Fig. 1 *a*, *d*) have black exterior surfaces with deep, parallel cord impressions running at a right angle to the coil. The interior surfaces are gray as is the paste. The other three sherds (Fig. 1 *b*, *c*, *e*) have gray exteriors with black interior surfaces and show paste coloring fading from black near the interior surface to gray at the outer surface. Like the others, these sherds show cord impressed exteriors with the impressions placed at a right angle to the coil, but the impressions are shallower and less distinct and tempering particles appear on the surface.

Tempering of the five sherds consists of a generous quantity of medium to fine quartz sand, with an occasional large particle. The sand grains are generally rounded but a few angular particles are present. Texture is granular with no distortion of the clay around the tempering particles. The paste is compact and the sherds tested 4 to 4.5 in hardness. Fracture, where it does not follow the coil lines, is jagged and irregular. Thickness ranges from 6 to 9 mm. All specimens are body sherds and there is nothing to indicate vessel form. Coil breaks can be clearly recognized, two on one sherd and one each on the other four. Two breaks present a flat surface, one shows a concave face, two are convex (Fig. 1 *a*), and one may best be described as concave-diagonal (Fig. 1 *b*). In only one instance does a sherd show evidence on more than one edge of having broken on the coiling line; this coil measures from 1.5 cm. to 1.7 cm. in width (Fig. 1 *d*).

In August, 1957, I examined the entire collection from Coal-oil Canyon, visited the site, and aided in making additional tests. A number of collections in the Fort Wallace Museum and in the possession of local collectors were also examined. The bulk of these collections con-

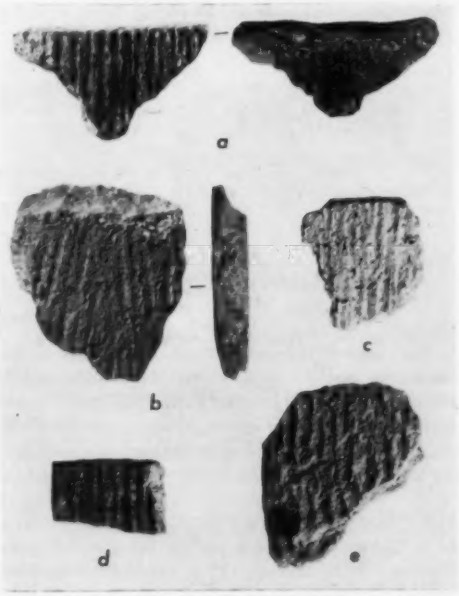

FIG. 1 [Metcalf]. Coiled sherds from Coal-oil Canyon, Logan County, Kansas. *a*, coil break at top, view at right tilted to show convex break; *b*, coil break at top, edge view at right to show concave-diagonal break; *c*, coil break at top; *d*, coil breaks at top and bottom; *e*, coil break at top. Length of *b*, approximately 4.3 cm.

sisted of arrowpoints and other chipped stone artifacts, but a number of sherds were present. Two more sherds showing breaks on coil lines were found in the collection of Frank Howard of Arapahoe, Colorado. These were said to have been "dug from a fire pot on top of a hill" at a site some ten miles west of Cheyenne Wells, Cheyenne County, Colorado, approximately 50 miles from Coal-oil Canyon. The two sherds in the Howard collection are very similar to the Coal-oil Canyon material except that they are much larger. Both are body sherds, with deep cord impressions in the exterior surface, placed at a right angle across the coils. One has a gray and one a gray-buff exterior and both have black interior surfaces. They differ little, if any, from the Coal-oil Canyon sherds in amount and size of the sand used in tempering, and the rather compact texture is granular and without distortion about the tempering particles.

I know of only a few sherds from the Plains which show unmistakable evidence of coiling. Those few are from a site of the Dismal River aspect, much later in date than the Coal-oil Canyon material and one in which southwestern influences have been detected. The sherds from Coal-oil Canyon suggest that collections from the western parts of Kansas, Oklahoma, and Nebraska, and that part of Colorado lying east of the mountains might be examined profitably for more evidence bearing on the distribution of coil-made pottery on the Plains, as well as on the direction from which it came.

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January, 1958

ANOTHER MAYA FALSIFICATION*

Abstract

The claims of antiquity and authenticity made for the *Manuscrito pictórico de la Cultura Maya sobre piel de mamífero* are false. It contains many elements and scenes copied from a variety of sources, Mixtec, Aztec, Teotihuacan, as well as Maya. Numerals are used in meaningless fashion; many copied items are obviously misunderstood

THE FACSIMILE PUBLICATION, *Manuscrito pictórico de la Cultura Maya sobre piel de mamífero* (Librería Manuel Porrúa, Mexico, 1957), constitutes the 33rd "Maya" falsification to be surely identified (Lizardi Ramos 1958b). Although the editor of this publication emphasizes in the introduction that detailed histological and chemical analyses were made of the animal skins on which the drawings are found, the publishers have not supplied a comparable archaeological analysis of the contents of the 105 plates of reproductions, the most important kind of analysis for any document which is claimed to be of prehistoric authorship. After exposing this collection of drawings as a falsification in the Mexico City press (Lizardi Ramos 1958c), I published in Spanish a detailed, almost plate by plate, comparative study of "Los Cueros Porrúa," as the material has come to be called (Lizardi Ramos 1958a). The following summary of this detailed analysis sets forth the major reasons for rejecting the Porrúa collection as an authentic Maya product.

Numerals are used in various ways which violate the Maya rules for numerical expression. The numerals drawn in outline, which appear on at least 45 of the plates of the reproduction (for example, Pls. 1b, 18–20, 66, 101), never take this form in the known Maya codices. However, the numbers painted in red in the codices are shown in outline in black-and-white reproductions of the codices (Villacorta and Villacorta 1930) to distinguish them from the black numbers, a distinction which is fundamental to the correct reading of the 260-day almanacs (Bowditch 1910: 20–36). These outline numerals in the Porrúa publication have no meaning in Maya numeration; they were copied from reproductions of the codices in which this convention was used.

The separation between rows of numbers which is so necessary in order to read Maya numerical series correctly is frequently missing (for example, Pls. 10, 20, 41, 62, 77). Sometimes the numbers are shown in triangular (Pl. 25) or other arrangements (Pl. 14), as if they were decorations rather than parts of calculations as in the codices. There are even artificial series of numbers, such as one through five (Pl. 68), one through seven (Pls. 46, 74), and one through nine (Pl. 63). In addition there are series of numbers which consist of up to 20 groups of units (Pl. 38) which represent numbers of absolutely astronomical magnitude, despite the fact that numbers of such size never appear in the known Maya documents.

There are a good many elements in "Los Cueros Porrúa" which are foreign in both style and content to the Maya system of representation. The Malinalli on Plate 12 is undoubtedly Mixtec (compare Zouche-Nuttall Codex 20). The sun discs with angular rays shown on Plates 103 and 105 resemble those of the Mixtec (the teponaztli in the British Museum, Saville 1925, Pl. 26), the Aztec (Piedra del Sol, Tizoc Stone), or the Maya Toltec (Morley 1956, Fig. 42). The disc on Plate 105 has two Ehecatl figures which are identical to those on Aztec stone sculpture. Moreover, there is an Ollin sign of Aztec type in the center of this same disc. There is a symbol on Plate 103 which resembles the pointed crown so typical of Teotihuacan art where it is associated with the mythological owl of the mural in the Temple of Agriculture (Marquina 1951, Pl. 22). Other non-Maya forms include an individual with four arms (Pl. 52) and Chinese-like dragons,

* The Editor acknowledges the assistance of William R. Holland in preparing this translation from the Spanish.

once with five feet (Pls. 95–7). The obscenities which appear in several of the reproductions (Pls. 58–61, 62, 64) are inadmissible as works of Maya art; they seem to be exaggerations of the scenes in Dresden Codex 38 *a* and 68 *c*. Neither can one accept as authentic the so-called "calendars" in the discs of Plates 95 and 99 and the square form of Plate 102 in which there are a number of ridiculous figures which are apparently supposed to represent the glyphs of the months of the Maya year. Often the gods in the Porrúa reproductions are shown without the name sign which is usually associated with them in the codices; conversely, the name signs appear without the figures of the gods which they identify.

A large number of the drawings are copied directly from authentic Maya sources. The Paris Codex, in particular, provided inspiration for the faked drawings. Among the items copied from it are the following: the Tun glyph with several added small circles which make it look like an Ahau (such as Pls. 28, 41, 54); persons seated or kneeling over this form of the Tun glyph (Pls. 1b, 89, 90) or over Celestial Bands (such as Pls. 5, 11); the aged god of the Uayeb (Pls. 6, 79); vessels containing food (Pl. 71). Examples of figures copied from the Madrid Codex include deer caught in traps (Pls. 50, 51) and men and women in the act of self-sacrifice (Pl. 65). The material copied from the Dresden Codex includes the following: the goddess of the hanged (Pl. 2b); the Venus god reproduced in black (Pl. 4); the night and day glyph (Pl. 7); a special version of God B (Pl. 18); women with birds (Pls. 11, 15); the woman carrying a god on her back with a tumpline (Pl. 42); a woman carrying a scroll symbol (Pl. 74).

The central figure of Waldeck's drawing of the Beau Relief in the Temple of the Lion at Palenque (Brasseur de Bourbourg 1866, Pl. 42) appears in Plate 36 of the Porrúa publication. The priests on the bas reliefs in the Temple of the Cross, the Temple of the Foliated Cross, and the Temple of the Sun at Palenque were certainly the inspiration for the figures in Plate 46 (Maudslay 1889–1902, Pls. 73, 80, 97). There are various versions of Glyph G which were copied from or adapted from those on the hieroglyphic monuments: Glyph G 6 in Plates 31 and 34 is similar to that on Copan H' (Thompson 1950, Fig. 34, No. 31); the versions of Glyph G 8 on Plate 31 are based on those illustrated by Thompson (1950, Fig. 34, Nos. 39–45); Glyph G 4 of Plate 32 is comparable to one on Ixkún 2 (Thompson 1950, Fig. 34, No. 24); Glyph G 5 on Plate 33 was inspired by Los Higos 1 (Thompson 1950, Fig. 34, No. 30).

Painted pottery also served as a source for the scenes in the Porrúa reproductions. The seated jaguar (Pls. 9, 49) was copied from a polychrome vessel from Uaxactún illustrated by Morley (1946, Pl. 87; 1956, Pl. 91). The animal is surrounded with outline dots of the type seen in Mixtec codices (Zouche-Nuttall Codex 24, 64). One of the litter bearers on the Ratinlinxul vase is faithfully copied on Plate 76 of the Porrúa publication (Morley 1946, Pl. 88 *b*; 1956, Pl. 92 *b*).

The most impressive evidence that "Los Cueros Porrúa" are a falsification comes from a comparison of Plates 39 and 57 with Discs H and F from the Sacred Cenote at Chichén Itzá. The sacrificial scene on Disc H has been copied with such accuracy that even the broken areas which disrupt the design on the disc have been incorporated into the Porrúa drawing (Lothrop 1952, Figs. 1, 10 *l*). The triangular break in the headdress of the priest carrying out the sacrifice is superimposed on the headdress in the copy on Plate 39. The other broken area cuts into a serpent on the edge of the original disc. Only the portion of the serpent unaffected by the break is reproduced in Plate 39. The copier completely misinterpreted the scene on Disc F (Lothrop 1952, Figs. 34, 23 *h*) and added a decoration to the headdress of the seated warrior on Plate 57 which is actually the shield held by a Toltec warrior standing behind the seated and wounded Maya fighter in the battle scene on the disc. I believe that Porrúa Plates 39 and 57 were copied directly from Morley (1946, Pl. 57; 1956, Pl. 57) or Lothrop (1952, Figs. 1, 34). Thus, the falsification was not produced until after 1946 at the earliest. It may have been made in 1952, or perhaps not until after Brainerd's 1956 revision of Morley's book.

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César Lizardi Ramos
Mexico, D. F.
July, 1958

THE WHISKEY DICK SHELLMOUND, WASHINGTON

Abstract

A layer of shells covered by a mixed aeolian and alluvial deposit was exposed by a road cut in a tributary of the Columbia River. Three occupation levels contained few stone tools, including burins and large knives in the lowest level. A contracting-stem point in the middle level places the site in the Frenchman Springs III phase, 4th to 11th centuries A.D. The latest level reflects increasing aridity; the streams became intermittent and the population moved to the main river.

THIS SHELLMOUND in the Vantage region of the Columbia Plateau is one-quarter mile from the main trench of the Columbia River on the first terrace of the Whiskey Dick which comes out of the eastern foothills of the Cascade Mountains to join the Columbia on the western edge of the Quincy Basin not far from the Schaake Village site (Swanson 1958). The excavations in 1954 were made possible by grants to Douglas Osborne from the Graduate College Research Committee of the University of Washington. The site was not recognized prior to 1954 because it is covered by an alluvial fan sloping out of a draw into Whiskey Dick. During the winter of 1953–54 widening of a road exposed the shell deposit. It was not possible to trench either the site or the fan extensively, so that geological relationships and the extent of the shellmound remain to be determined. The layer of shells is covered by a silt deposit which is partly the result of the alluvial action that formed the fan and partly the result of wind action. The artifacts from Occupation A, the latest of the three, are found at the base of this silt.

The shells are of two types: *Margaritana magaritifera falcata* (Gould) and *Gonidea angulata* (Lea). These indicate by position rather than by type that the climate has become increasingly drier since the site was occupied. Freshwater clams are now to be found only in the Columbia River, whereas once they must have been available in this and other tributaries. The shell deposit varies in thickness. In one place it is approximately 1.5 feet thick and is divided by a line of angular rocks which show no sign of workmanship. Occupation B occurs above this line of rocks, Occupation C, below. Beneath the shell bed is a loam containing large angular and subangular blocks of basalt, apparently a part of the terrace on which the site rests. Two deer molars were found in Level B, but no mammal bone. This absence is probably not caused by poor conditions of preservation because the slope is well drained and the soil is alkaline. Just what this absence of bone means is not yet clear, but another site of this same age also lacks bone material.

Table 1 provides a summary of most of the artifacts found except for the unclassifiable items. This site suffers from a chronic Plateau situation — lack of artifacts. It is

Table 1. Common Artifact Types

Types	Level A	B	C	Total
Cores				
Polyhedral	3		13	16
"Brandon"			1	1
Blades				
Unworked, unused	3	1	3	7
Flakes				
Unworked, unused	8	11	7	26
Unworked, used			10	10
Scrapers				
Rough flake, single edge	1		3	4
Rough flake, double edge			1	1
Rough flake, end			1	1
Triangular	1		6	7
Keeled end	2		1	3
Thick flake		1	1	2
Thumbnail	1	1	1	3
Small core		1		1
Knives				
Large, triangular cross section	4	4		8
Large leaf		2	4	6
Irregular	1	1		2
Projectile points		2		2
Blade tools	2	3	16	21
Burins				
True burin technique		5	8	13
"Retouched" technique	3			3
Milling stones			1	1
	29	32	77	136

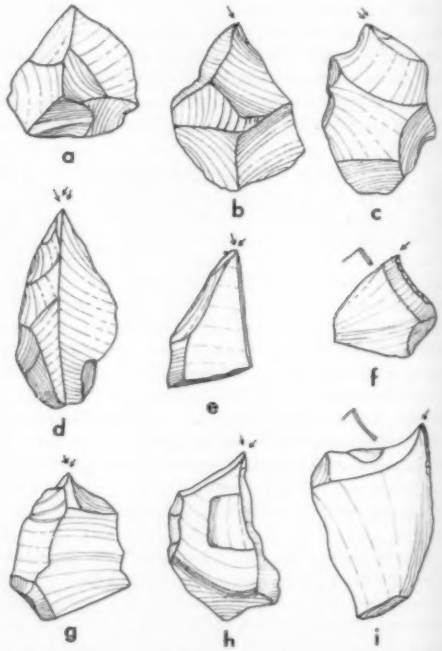

Fig. 1 [Swanson]. Stone artifacts from Occupation C, Whiskey Dick Shellmound. *a*, triangular flake scraper; *b–i*, burins. *a–c*, *e*, flint; *d*, *g*, *h*, petrified wood; *f*, *i*, chert. Length of *i*, 2 inches.

necessary to analyze the material closely to detect any change. Occupation C, stratigraphically the earliest, is characterized by a large number of polyhedral blade cores, blade tools, and burins. The burins are produced in the classic fashion described by Leakey (1954: 136–7); the types from this occupation (Fig. 1) continue into Occupation B. In Occupation A, however, they are replaced by "burins" produced by retouch instead of the true burin technique. Large knives with a lenticular cross section are present in Occupation C, but in the other levels the knives have a triangular cross section with the base of the triangle on one or the other edge (Fig. 2 *f*, *i–k*). Blades are present throughout the sequence but change in character from the lowest level (Fig. 2 *c*, *e*) to the top level (Fig. 2 *h*). The larger, earlier blades appear crude, but the technique is not. When it is applied to flint it produces excellent specimens. Most of the blades are made of petrified wood. Two points come from Occupation B (Fig. 2 *a*, *b*) and the smaller of them is typical of the Frenchman Springs III phase in the Vantage region. Of technical interest is the implement with the striking platform preserved (Fig. 2 *d*). The faceting of this platform indicates careful preparation of the core platform. The transversely keeled flake scraper (Fig. 2 *c*) is almost unique in this area.

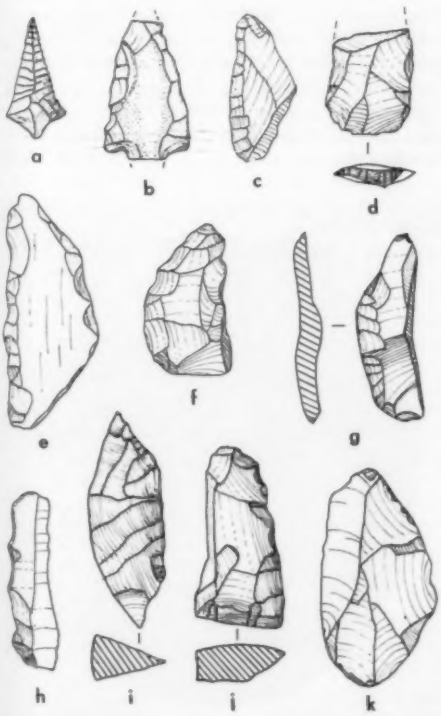

FIG. 2 [Swanson]. Stone artifacts from the Whiskey Dick Shellmound. *a*, *b*, *h–j*, Occupation B; *c*, *e*, *k*, Occupation C; *d*, *f*, *g*, Occupation A. *a*, jasper; *b*, *d*, *f*, *g*, *i*, *j*, flint; *c*, *e*, petrified wood; *h*, chalcedony; *k*, chert. Length of *e*, 2¾ inches.

Because of the presence of the contracting-stem point (Fig. 2 *a*), the site probably belongs to the Frenchman Springs III phase which dates from A.D. 300 or 400 to about 1000 or even somewhat later (Swanson 1956). The geology on which this estimate is based is tenuous and uncertain, but it is the best available at the moment. This period of time precedes the prehistoric development of the later Plateau pattern of life. Sites of this phase tend to be found in tributaries rather than on the Columbia suggesting that the presently intermittent streams were once perennial. These streams do not now support beds of freshwater mussels, which are found in the region today only in the Columbia River, but they must have in the past. Sites from the phases following the Frenchman Springs series are on the Columbia River where mussels were but slightly used. Climatic change was apparently accompanied by an economic shift. The covering of the shellmound by an alluvial fan indicates a change toward increasing aridity at the end of Frenchman Springs phase.

The Whiskey Dick Shellmound confirms the definition of Frenchman Springs III phase as established in 1956. All of the types of implements at this site, with the exception of knives from Occupations A and B (Fig. 2 *f*, *i*, *j*), have been found in the Frenchman Springs phase. Occupations A and B differ as far as these knife types are concerned and Occupation A lacks the true burin. This change, together with the decline of blades, suggests a transition into the later phases which lack the burin.

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Pocatello, Idaho
November, 1957

TWO WOODLAND VESSELS FROM NORTH DAKOTA

ABSTRACT

The demands of salvage archaeology in the Missouri Basin have directed attention to those culture complexes concentrated along streams. Two previously undescribed and unusual vessels from North Dakota suggest the presence there of Woodland cultures not recognized in the riverine regions.

RECENT ARCHAEOLOGICAL WORK in North Dakota has been confined primarily to the Missouri and other valleys which will be partially flooded with the com-

pletion of several reservoirs. This work has contributed much to our knowledge of the prehistory of the Northern Plains, but it has also led to the neglect of the areas outside the great river valleys. Two complete pottery vessels from Woodland sites, now in the collections of the State Historical Society of North Dakota, are described here in order to focus attention on problems which have not been touched upon in the recent archaeological investigations in North Dakota.

The Sydna Vessel

This pot, which is quite different from other local specimens, is reputed to have been found in the "right hand" of a female skeleton in the Nelson Mound, Sydna Township, Ranson County, North Dakota, which was originally dug by Edward F. Milligan and Eugene A. Burdick many years ago (Fig. 1 *a*).

Paste

Method of manufacture: Probably lump-modeled, and paddle-and-anvil finished.

Temper: Fine sand, some particles up to 1 mm. in diameter.

Texture: Compact, but eroded. Core and surface are laminated; some parts are crumbly.

Hardness: 2.5 (Moh's scale).

Color: Light brown exterior.

Surface Finish

The entire vessel is irregularly smoothed; the interior is horizontally smoothed between lip and neck.

Decoration

The rim has 14 vertical projections, 1 cm. high from trough to crest and spaced 2 cm. apart from crest to crest. A zigzag line encircling the rim was apparently made with a splintered tool, because several grooves are visible in the incision. A flange encircles the vessel above the shoulder; it is 1.5 cm. high and projects 1.8 cm. from the vessel wall.

Form

Rim: Gently S-shaped; 6.7 cm. high and 6 to 8 mm. thick. Lip is round and averages 6 mm. thick.

Neck: Slightly constricted. The rim joins the body in a smooth curve, although this juncture is complicated by the presence of the flange.

Body: The shoulder slopes down at a 50° angle. Below the angular shoulder is a globular body with a round bottom.

Size: Total height is 14.7 cm., diameter at shoulder 11.5 cm., diameter at neck 9.6 cm. Capacity, when filled to top of flange, is 1.25 pints of water.

Appendages: Four rounded lateral lugs are equally spaced around the rim below the troughs of the vertical projections from the rim.

This unique vessel contains familiar elements in an exaggerated form. The really unique feature is the fact that the rim comprises nearly half the total height. It is possible that it may be a special grave offering which could not be duplicated in village finds.

A vessel much like this one was found at Bemidji, Minnesota, together with some bone needles (Wilford 1943). The Bemidji vessel is 4 cm. shorter than the Sydna pot and lacks the vertical projections on the lip as well as the four lateral lugs below them. It is a much finer piece with a smooth finish and an evenly modeled flange. The vessel was apparently made in two parts. The upper part, consisting of rim and flange, was joined to the lower vessel body at a line of juncture at the base of the flange. It is possible that the Sydna vessel was similarly made with the flange reinforcing the juncture between the two parts. The Sydna vessel seems to be a less skillfully made version of the Bemidji pot. The line of juncture might also indicate that some coiling was used in making these pots. The most important difference between the two vessels is the shell tempering of the one from Bemidji.

Fig. 1 [Wood]. Woodland vessels from North Dakota. *a*, the Sydna vessel, 14.7 cm. high; *b*, the Crosby vessel, 11.5 cm. high.

This trait places it in the Late Woodland horizon. Wilford believes that it is a Mississippian trade piece and that both vessels are Late Woodland. This assignment is feasible because the Sydna vessel came from a burial mound.

The Crosby Vessel

This vessel was found on the east side of Long Creek, near Crosby (T164N, R95W, S31, SW¼), Divide County, North Dakota, in a blowout area near the stream (Fig. 1 *b*). There were no associated artifacts and it is not likely that the place was an intensively occupied campsite.

Paste

Method of manufacture: Possibly lump-modeled and paddle-and-anvil finished, although some horizontal cracks in the vessel suggest the possibility that it was coiled.

Temper: Coarse grains of angular sand, averaging 1 mm. in diameter.

Texture: The paste is smooth, but the surface treatment has resulted in a coarse, rough surface.

Hardness: 3.5 (Moh's scale).

Color: Light gray to nearly black with some light buff areas. The interior is light brown.

Surface Finish and Decoration

The exterior was vertically roughened from lip to bottom by impressing the moist clay with a paddle wrapped with coarse fiber cords. The interior is smooth. Diagonal indentations were applied to the lip with a blunt tool or dowel of small diameter.

Form

Rim: Straight, with lip beveled on the exterior as a result of decoration; 4 to 5 mm. thick.

Neck: The rim joins the body in a smooth curve; the neck is not constricted.

Body: The vessel is globular and elongated with a somewhat angular shoulder and a round bottom.

Size: Total height is 11.5 cm., diameter at shoulder 10.8 cm., diameter at neck 9.2 cm. Capacity, when filled to the neck, is 1.75 pints of water.

An examination of the literature for similar pottery reveals no close parallels in adjoining regions. A tentative assignment to the Woodland horizon, however, is suggested by the cord roughening and the grit tempering. Cord-roughened pottery is rare in western North Dakota, although it is more plentiful in the eastern part of the state. There are some sites with cord-roughened pottery along the Souris River in the central part of the state, but neither this pottery nor that from the Woodland site near Williston, North Dakota (Wood 1956), bears any great similarity to the Crosby vessel. There seems to be evidence, in the form of numerous small collections of rather diversified cord-roughened sherds, to suggest the presence of several related but distinct Woodland cultures in North Dakota. The sporadic references to Woodland remains from the state in the past have not yet incited the interest of investigators, but with the completion of the reservoir projects perhaps it will be possible to concentrate on the less spectacular, earlier complexes in the Northern Plains.

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February, 1958

DATING THE ULUA POLYCHROME COMPLEX

Abstract

Distinctive polychromes from the Ulua valley, northwestern Honduras, formerly dated from possibly Early Classic to the conquest, are restricted to Late Classic. Ulua wares have Late Classic associations at Copan and other sites. A newly demonstrated Early Classic occupation of the Ulua valley is not found at the major polychrome sites. Plumbate is not associated with the Ulua complex and in northeastern Honduras it first appears in the Cocal horizon overlying the Late Classic Selin horizon in which Ulua pottery occurs.

THE ULUA POLYCHROME COMPLEX of western Honduras consists of various styles of elaborately decorated pottery. Though these styles have long been known, they have never been fully described or accurately dated. What we now recognize as the Ulua polychrome complex was first described by Gordon (1898) who found it in the Ulua valley with Playa de los Muertos ware. Many years later the Playa de los Muertos assemblage was isolated from the Ulua material and shown to be earlier (Popenoe 1934). Most of our knowledge of the Ulua pottery and chronology is derived from the stratigraphic testing of sites in both the Ulua and Yojoa drainages by the Smithsonian Institution — Harvard University Archaeological Expedition to Northwestern Honduras in 1936 (Strong, Kidder, and Paul 1938). The results of this testing were a new classification of the Ulua pottery and a longer, more detailed, but still incomplete sequence.

Strong, Kidder, and Paul revised the previous classifications of Gordon (1898) who divided the polychromes into three groups and Vaillant (1927) who subdivided the same collection into five categories. They related the Ulua pottery to two major traditions, Mayoid and Bold Geometric, which were further subdivided into lower and upper types that seemed to reflect temporal differences at the sites of Santa Rita and Flores (Strong, Kidder, and Paul 1938, Table 2). Since the distinctions between Mayoid and Bold Geometric as well as between lower and upper have never been carefully drawn, it seems wise at our present state of knowledge to refer to the stylistic categories by site names rather than by type names. Therefore, the term Ulua polychrome complex is used here to encompass both Mayoid and Bold Geometric styles unless otherwise stated and the lower and upper types of both styles are Santa Rita and Las Flores, respectively.

The Ulua valley chronology is based on a seriation of collections from Playa de los Muertos, Santa Rita, Las Flores, and Naco. The sequence begins with a Preclassic Playa de los Muertos horizon and ends with the 16th century site of Naco. There are two gaps, the first between the Ulua bichrome and Ulua polychrome horizons at Santa Rita, and the second between the Ulua polychrome levels at Las Flores and the material from Naco (Strong, Kidder, and Paul 1938, Table 1). These gaps leave the Ulua polychrome complex floating somewhere between

late Preclassic and the conquest period. Whether the Ulua polychromes were manufactured during the Early Classic, or whether they were still being made in Postclassic times are problems which cannot be answered by the data now available. We do know, however, that there is ample evidence for placing the bulk of the polychrome complex in the Late Classic.

This dating is based partly on stylistic analysis and partly on cross-dated material from other sites. The cylindrical vases from Santa Rita are decorated with glyph-like elements and processional or dancing figures which are unmistakably in a Late Classic Maya tradition. At Copan the Ulua polychromes are found in a Late Classic context (Longyear 1952: 75), and a similar placement is recorded for many sites in El Salvador. Ulua polychrome trade sherds appear at Los Llanitos where they are tentatively placed by Longyear (1944: 37) between 9.8.0.0.0 and 9.18.0.0.0. At least one whole Ulua polychrome vessel is associated with Copador polychrome at the Club Internacional site (Boggs 1945, Fig. 1 *g*). Copador ware is dated as full Classic at Copan. Perhaps the most conclusive evidence comes from Tomb 1 at Tazumal where in a cache of 20 pots we find Maya vessels decorated in Tepeu 1–2 styles associated with Ulua Bold Geometric (Longyear 1944: 70) and Santa Rita Mayoid pottery (Boggs 1943, frontispiece [not a Maya trade vessel as the caption might suggest]). Thus, both Bold Geometric and Santa Rita Mayoid styles of the Ulua polychrome complex are equated with Copador ware, Tepeu 1–2 Maya pottery, and Late Classic Maya shapes and designs. There can be little question that the Ulua polychromes are in part at least coeval with the Late Classic period in the Maya area, but there is a problem as far as the initial and terminal dates of the complex are concerned. Longyear (1952: 75) succinctly states the problem:

> We can now say definitely that the Ulua-Yojoa . . . polychromes were in existence by 9.13.0.0.0 and continued at least until 9.19.0.0.0, when Copan was abandoned. . . . The Copan evidence gives no clue as to their first beginnings or duration in other areas, particularly at their own centers of manufacture.

Terminal Date for the Ulua Polychromes

Several writers have suggested that the Ulua polychrome complex lasted into Postclassic times. Vaillant (1927: 271) and Longyear (1947: 3) merely consider the possibility of such a placement without offering a terminal date, and Strong (1948: 115) hints that all or part of the complex lasted into the 16th century. He adds that there is as yet no proof for this late placement, but Canby (1951) argues from the evidence he recovered at Yarumela that the Ulua polychromes were being made as late as the conquest period. The long stratified Preclassic sequence at Yarumela ends with a horizon containing Usulután ware, Ulua bichrome, and Playa de los Muertos figurines. Ulua polychromes are the most recent types found at Yarumela, not in a stratified position above the Preclassic material but at the periphery of the site. Canby bases his late placement of the Ulua polychromes on their lateness in both the Ulua and Yarumela sequences and on the fact that a few Ulua polychromes were found at the conquest-period site of Naco. In order to reconcile his 16th century date with the established Late Classic associations of the Ulua polychromes elsewhere, Canby suggests the use of a 10.10.0.0.0 correlation of Maya and Christian calendars. Such a correlation is unacceptable because it allows just a little over 100 years for the entire Postclassic development. Moreover, some recent radiocarbon dates may be interpreted as favoring the 12.9.0.0.0 correlation (Satterthwaite 1956). On the other hand, if we use the presently favored 11.16.0.0.0 correlation and accept the 16th century date for Ulua polychrome, we assign a time span of more than 800 years to the Ulua complex. Since this is an unusually long persistence for a ceramic complex of this type, either the 11.16.0.0.0 correlation is wrong, or the Ulua polychromes did not persist into the conquest period. The second alternative seems the more plausible, especially with the Late Classic associations of the Ulua complex. An even more plausible explanation, however, is that the Ulua polychromes ceased to be made somewhere near the close of the Late Classic. Evidence to support this belief comes from northeastern Honduras where a late ceramic sequence has been established for the Bay Islands and the Olancho valley.

This chronology (Epstein 1957) is based on material obtained by Junius Bird in 1931 and by A. V. Kidder, Gordon Ekholm, and Gustav Stromsvik in 1950. Kidder, Ekholm, and Stromsvik excavated a trench at the 80-Acre site on Utila Island which produced two clear-cut horizons. This information is amplified by their additional excavations on the mainland and by Bird's material from around Guaymoreto Lagoon. Bird's excavations in the Bay Islands have already been published by Strong (1935). The early period at the 80-Acre site has been named the Selin horizon, the late one, the Cocal horizon. Both have early and late phases. This new sequence applies to the Olancho valley ceramics excavated by Strong (1934).

The pottery from the first part of the Selin horizon is in many ways quite similar to that from the polychrome levels at Santa Rita and Las Flores. The culture of the Bay Islands and the Olancho valley is considered to be largely an eastern extension of Ulua valley culture. Trade sherds from Ulua include both Santa Rita Mayoid and Las Flores Mayoid types. A number of similarities between Selin and Maya shapes and designs suggest that the Selin horizon culture was strongly influenced by Lowland Maya culture and demonstrate that at least the first part of the Selin horizon is contemporary with the Late Classic or Tepeu period in the Maya area. The second part of the Selin horizon is marked by the absence of Classic Maya influence and the appearance of an appliquéd monochrome tradition that has its source in Nicaragua and Costa Rica. Strong (1948: 114–5) has called much of this material the North Coast Appliqué style. Dating is presumably Postclassic but pre-Plumbate. There is no evidence of trade from the Ulua valley.

The first part of the Cocal horizon is dated through the presence of Plumbate trade sherds. There are a few pieces of Bay Island polychrome in this Postclassic period, but the dominant pottery is a version of the appliquéd ware that intruded during the earlier Selin horizon. The

second part of the Cocal horizon seems to differ from the first only in minor changes in forms and designs. This later phase is known from only two sites and is poorly documented. A single trade sherd of Naco polychrome suggests that the Cocal horizon ended at the time of the conquest or shortly before. None of the Ulua polychromes occurs in pure sites of this horizon.

The Selin-Cocal sequence makes possible a reconsideration of the problem of the terminal date for the Ulua polychrome complex. The Late Classic Selin horizon reinforces the already established association of Ulua polychromes with Maya Late Classic pottery at Copan and various sites in El Salvador. The absence of Ulua polychromes in the Plumbate-period Cocal horizon and the lack of Plumbate sherds in the Ulua excavations of Strong, Kidder, and Paul indicate that the Ulua polychromes were not made after the appearance of Plumbate. It is difficult to determine whether the Ulua types were made during the period between the end of the Classic and the introduction of Plumbate. However, no Ulua polychrome sherds occur in the small collections available from sites of the second part of the Selin horizon, the northeastern Honduras equivalent of this restricted Postclassic but pre-Plumbate period. On the basis of present evidence it appears that the Ulua polychromes ceased to be made at the end of the Maya Classic period or very shortly after.

Initial Date for the Ulua Polychromes

One problem connected with the establishment of a beginning date for the Ulua complex is the gap between the Ulua bichrome and Ulua polychrome horizons which is stratigraphically documented at Santa Rita with some confirming evidence from Yarumela where superposition is lacking. The problem, of course, is the length of time represented by the sterile layer at Santa Rita, or in broader terms, the amount of time between the bichrome and polychrome horizons. The demonstration that the Ulua bichrome horizon extended over a period comparable to the Maya Early Classic, or that the Ulua polychromes began sometime during the Early Classic, or both, would help to narrow, even eliminate this apparent gap in the sequence. It is possible, of course, that the Early Classic period is weak in the Ulua sequence because Preclassic traits persisted later in the Ulua valley than in other areas. The Ulua bichrome horizon at Yarumela contained both Playa de los Muertos figurines, which have widespread Preclassic associations, and Usulután ware, which is known to have persisted into the Early Classic at Copan (Longyear 1952). It is possible, therefore, but not probable, that the Ulua bichromes have an Early Classic date.

There is a suggestion in Strong's (1948, Fig. 15) chart of the temporal distribution of Honduranian pottery types that the Ulua polychromes might be pushed back into the Early Classic. Although there is not sufficient evidence for this earlier placement of the Ulua types, it is of course most probable that some kind of polychrome pottery was being produced in the Ulua valley in Early Classic times. However, the Santa Rita Mayoid and Bold Geometric styles cannot be given such an early placement because of the form and design resemblances between Santa Rita Mayoid and Late Classic Maya pottery, because of the Late Classic associations of Santa Rita styles at Copan and sites in El Salvador, and because of the striking absence of any Early Classic time markers at Santa Rita or at sites containing Santa Rita style pottery. In fact, it is interesting to note that despite the proximity of the Ulua valley to the Maya area no basal flanged bowls were found in the extensive excavations of Strong, Kidder, and Paul. Even if the Ulua population were non-Maya and therefore might not have had much use for a form apparently important in Maya ritual (Longyear 1952: 32), it would be logical to assume that some of these time markers would have been traded into some Early Classic sites in the Ulua valley. Although Strong, Kidder, and Paul did not find any basal-flanged pottery, Gregory Mason and Dorothy Popenoe have excavated basal-flanged vessels in the area. Thus, while there may not have been an Early Classic occupation at the sites excavated by Strong, Kidder, and Paul, the vessels collected by Mason and Popenoe indicate that the Ulua valley was occupied during the Maya Early Classic. These vessels are in the Museum of the American Indian, Heye Foundation.

The Mason collection is a selected group of more than 500 catalogued items including whole pots, figurines, and whistles as well as sherds collected at the United Fruit Company Farm 2 near the mouth of the Ulua River. The collection was received by the museum in 1933. There are no field notes to supplement the catalogue information. An occupation extending from the Preclassic through the Classic periods is indicated by the presence of Playa de los Muertos pottery and figurines, Usulután ware, two basal-flanged bowls, both "lower" and "upper" Mayoid and Bold Geometric types, and Mayoid sculptured pottery (Strong, Kidder, and Paul 1938, Pl. 6 *d*). A complete bichrome vessel with tripod legs of characteristic Naco form (Strong, Kidder, and Paul 1938, Pl. 3 *g*, *u*) suggests a late preconquest or historic period at the site. There are also small quantities of unfamiliar polychrome types which are apparently absent at Las Flores and Santa Rita and which must be either earlier or later than the Ulua polychrome complex as it is now known. The two basal-flanged bowls in the Mason collection (Figs. 1 *a*, *b*, 2 *a*, *b*) share enough features to suggest a common source. The sandy clay contains small quantities of mica and the temper appears — without the aid of a hand lens — to be calcite. Both vessels are black-on-red-on-buff polychromes. The interiors are completely red slipped, but the exterior walls are slipped red in panels only, the space between the panels remaining the basic buff of the unslipped vessel. Curvilinear motifs of non-glyphic character are painted in black over the red-slipped panels. The flange on both vessels is decorated with a band of triangles, a common decorative feature at Uaxactún during Tzakol 1–2 times (Smith 1955, Vol. 2, Fig. 26 *b* 2–4). One of the Mason sherds (Fig. 1 *a*) greatly resembles a Type B bowl from Copan (Longyear 1952, Fig. 117 *f*) which is believed to be of Petén derivation.

Fig. 1 [Epstein]. Basal-flanged bowls collected by Gregory Mason at the United Fruit Company Farm 2 site in the Ulua valley. *a*, see Figure 2 *a* for profile; *b*, see Figure 2 *b* for profile. Photographs courtesy of the Museum of the American Indian, Heye Foundation.

The vessel from Playa de los Muertos in the Popenoe collection at the Museum of the American Indian (Fig. 2 *c*, *d*) is in the same tradition as the Mason vessels. This sherd is badly eroded and most of the black paint is gone, but enough of the bare gray outlines remain to provide a hint of what the original design was like. The decoration resembles that of the Mason vessels in its alternation of red-slipped and unslipped panels on the exterior wall and in the band of triangles on the basal flange. It differs from the Mason bowls in having one long panel arranged in areas of black, red, and buff and in having no black paint over the red slip. Unfortunately, the Popenoe collection itself is too widely dispersed at the museum to characterize it in detail. It can be noted, however, that the collection includes a number of whole Playa de los Muertos vessels and figurines as well as some polychrome pieces of types which, as in the case of the Mason collection, have not been described for the Ulua valley.

The presence of these basal-flanged vessels in Ulua valley sites indicates that there was an Early Classic occupation in the area. On the other hand, the absence of this characteristic Early Classic form at Santa Rita confirms the conclusion already reached that Santa Rita is a Late Classic site. The most logical beginning date for the Ulua polychromes is the beginning of the Late Classic.

These three basal-flanged bowls make possible some speculations concerning ethnic identity, settlement pattern, and population density. It has long been assumed that the Maya lived as far east as the Ulua River (Lothrop 1939), but recently Longyear (1947, Figs. 2, 3) has presented excellent evidence to show that the Ulua valley was occupied by the Lenca during Late Classic times and by the Jicaque in the 15th century. The three vessels described here may throw some light on this problem if their point of manufacture can be located. The immediate and probably the safest assumption is that they were trade pieces from some unidentified source in the Maya area. However, the use of vertical panels separated by unslipped areas seems to be more of an Ulua than a Maya procedure. It is particularly surprising and perhaps misleading that three such vessels should appear at all in the small collections from United Fruit Company Farm 2 and Playa de los Muertos. If these two samples are representative, basal-flanged bowls seem far too common in the Ulua area to be trade pieces. If the three vessels were not made in the Maya area, but in the Ulua instead, then there is good reason for extending Maya rather than Mayoid culture into the Ulua area during Early Classic times. When this tentative conclusion is combined with Longyear's suggestions, it is possible to conclude that Maya culture reached its maximum eastern extension in Honduras during Early Classic times. The later periods, at least in Honduras, were marked by a diminution of Maya influence, and after Late Classic, a collapse of Maya-Ulua contacts.

FIG. 2 [Epstein]. Basal-flanged bowls from the Ulua valley now in the Museum of the American Indian, Heye Foundation. *a, b*, profiles of vessels collected by Gregory Mason at the United Fruit Company Farm 2 site, see Figure 1 *a, b* for photographs; *c, d*, profile and design on exterior wall and flange of vessel collected by Dorothy Popenoe at Playa de los Muertos.

This review of Ulua culture history shows that greater seriation has been necessary for the construction of long sequences in the Ulua valley than in other parts of Mesoamerica. There is no unbroken record covering even the late Preclassic to Postclassic in the Ulua area. This situation suggests a settlement pattern consisting of abandonment and later reoccupation. Since most of the sites so far studied are close to the river, many of the movements now indicated by the excavated evidence are more likely due simply to the fluctuations in the level of the river rather than to the pressures of war or the results of disease. Additional inferences are made possible by the considerable depth of the polychrome deposits at Santa Rita and Las Flores. If I am correct in believing that these deposits were laid down during the Late Classic or some part of it, then the size of the middens indicates a sizable population. It is known from historical sources that the Ulua was also densely populated in the 16th century. Thus, in spite of local movements from site to site, the valley seems to have had a large population from at least Late Classic to the conquest period. No major demographic shifts are indicated as in the Maya area. Why some regions should have supported large stable populations and others not is one of the more tantalizing problems of Mesoamerican archaeology.

CONCLUSION

The Ulua polychrome complex is known from the sites of Santa Rita and Las Flores in the Ulua valley of northwestern Honduras. The evidence now indicates that the occupation of these two sites falls entirely within the Late Classic period. Although the basal-flanged bowls from United Fruit Company Farm 2 and Playa de los Muertos demonstrate that there was an Early Classic occupation in the Ulua valley, these early time markers are absent at Santa Rita. The forms and designs of Santa Rita pottery resemble those of Late Classic Maya ceramics and Santa Rita Mayoid styles occur in well documented association with Late Classic material at Copan and sites in El Salvador and northeastern Honduras. No Plumbate sherds have been found at Santa Rita and Las Flores and in northeastern Honduras Plumbate first appears in the Cocal horizon which both lacks Ulua polychromes and overlies the Selin horizon in which the Ulua types do occur. Thus, the Ulua polychrome complex can be dated from the beginning of the Late Classic to sometime prior to the introduction of Plumbate, probably the close of the Late Classic or very shortly thereafter.

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April, 1958

REVIEWS

Edited by Donald Collier

A History of Technology, Volume I: From Early Times to Fall of Ancient Empires. Edited by Charles Singer, E. J. Holmyard and A. R. Hall, assisted by E. Jaffé, R. H. G. Thomson and J. M. Donaldson. Oxford University Press, Oxford, 1954. lv+827 pp., frontis. (in color), 570 figs., 36 pls., tables, maps. $26.90.

A History of Technology, Volume II: The Mediterranean Civilizations and the Middle Ages, c. 700 B.C. to c. A.D. 1500. Edited by Charles Singer, E. J. Holmyard, A. R. Hall, and Trevor I. Williams, assisted by E. Jaffé, Nan Clow, and R. H. G. Thomson. Oxford University Press, Oxford, 1956. lix+802 pp., frontis. (in color), 695 figs., 44 pls., 7 tables, maps. $26.90.

These books are the first two of a five-volume survey of technology, the final one of which appeared late in 1958. Encompassing so broad a topic, it is natural that the work presents many facets to its reviewers. Here it is being considered from the viewpoint of anthropology in general, from American archaeology in particular, and lastly from my own interest in primitive technology. Other viewpoints are found in reviews appearing in many journals; one in particular of interest is that by Lewis Mumford in *The New Yorker* (Sept. 27, 1958).

"The main object of this work is to provide students of technology and applied science with some humane and historical background for their studies." The editors "have not, however, sought to provide, even in outline, a history of material civilization as a whole, but have felt justified in concentrating upon one of its aspects — a history of how things have been done or made." The editors have presented a thoughtful and balanced picture but deliberately omitted areas which have been "adequately treated elsewhere" such as the development of medicine and architecture. Even with these limitations the editorial problem of selectivity has been great and it is reflected in the volumes themselves. In Volume I the areal scope of the work is defined as "opening with man as everywhere a hunter." It then considers the Near East and its first "civilizations." By Volume II the scope is the Mediterranean and in the later volumes it is Europe (and the New World in the 19th century). All volumes are under the senior editorship of Charles Singer, although other staff members changed from time to time. The project must have been long and expensive, and was made possible by an endowment from a major British chemical firm. The books are beautifuly made and lavishly illustrated. They are a pleasure to use.

Each volume comprises a series of essays on discrete topics prepared by a specialist in the field. Volume I contains 31 chapters grouped in seven parts: Basic Social Factors, Food-Collecting Stage, Domestic Activities, Specializing Industries, Utilization of Metals, Transport, and the Preparation for Science. These are written singly or jointly by 28 scholars, many of whom are well known to anthropologists, such as Childe, Oakley, Leakey, Forde, and Zeuner. Every chapter is essentially self-contained although there are occasional cross references. Each can be picked up and read by itself, despite the avowed purpose that "This work is intended for continuous reading, being designed as a course of study."

Documentation varies. Some chapters have none, others have references to cited works, others have a short reading list. No attempt is made to present a full bibliography of any topic. The organization of chapters is fundamentally chronological in nature and generally a practical one. In some cases, though, it is cumbersome or puzzling. Chipped stone tools, for example, are considered in chapters 1, 6, and 18. The placing of some material is somewhat arbitrary; a brief discussion of Mayan calendrical practices and mathematics being put in Chapter 6 (*Primitive Time-Reckoning*) rather than in Chapter 31 (*Ancient Mathematics and Astronomy*) which is devoted solely to the Near East. Then too, later chapters discuss "fine" metal, ivory, and woodwork while more ordinary working in these materials is presented earlier.

Looking at the book as a whole, Part I is perhaps the most impressive. This is probably because it offers a greater amount of interpretative and less descriptive material. Of the five chapters in this part, I found the first, *Skill As A Human Possession*, most informative, with the section on use of tools by lower animals well presented. Much of this chapter is familiar to all of us but the data have a freshness due to the manner of presentation. Childe's chapter, *Early Forms of Society*, also gives many of his familiar ideas but in a more organized presentation. Harrison's *Discovery, Invention, and Diffusion*, while not up to A. L. Kroeber's writing on the subject, is competent. The question of diffusion or invention for New World cultural developments is briefly examined. *Speech and Language* by A. Sommerfelt is an excellent brief exposition of the topic.

In discussing the remainder of Vol. I, I must pass over many chapters. Most are adequate, some are excellent. Special note can be directed towards the chapters on the cultivation of plants and domestication of animals by F. E. Zeuner and *Extracting, Smelting and Alloying* by R. J. Forbes. *Rotary Motion* by Childe, emphasizing by a variety of considerations a very fundamental principle, is certainly one of the more important chapters. Perhaps the poorest is Leakey's *Graphic and Plastic Arts*. In general the major weakness throughout the volumes is the limited use of ethnographic data as illustrative of possible solutions to prehistoric problems. The one exception is Daryll Forde's *Foraging, Hunting, and Fishing*. He draws widely on data from all parts of the New and Old Worlds.

Many of the readers of this journal will be interested in *Pottery*, by Sir Lindsay Scott. In general it is disappointing, with a limited scope showing little awareness of the

voluminous New World literature. The author laments the lack of technical studies on archaeological pottery, but makes no reference to the work of Anna O. Shepard. Wide open for discussion are many of Sir Lindsay's general statements. He says that "Pottery is indeed of its very nature a substitute material, and has itself no characteristic form. The shapes which we think of as characteristic of pottery are the product, not of clay as a material, but of a particular method of working clay — by spinning on the potter's wheel." Continuing he notes that vessels of wood and leather, baskets, gourds and eggs are all imitated in pottery at "low levels of cultures"; but that "In more advanced societies, pottery frequently has been, and still is, a substitute for metal. The history of pottery is accordingly largely moulded by the history of other materials."

These assumptions may be reasonable to one working solely in Near Eastern ceramics, about which I am not qualified to judge. However, they do not make sense in terms of the New World or Asia. Were not the Shang Bronzes derived from pottery rather than the reverse? Is it not generally considered that the Li and Ting ritual vessel shapes were derived from tripod pottery vessels, and does not the surface decoration of ritual bronzes appear to have developed from complicated stamped pottery? Scott (p. 401) sees the reverse as true! Far from being a substitute material, pottery is unique. Until the development of modern artificial plastics the world had no plastic equal to clay, which could be shaped and handled like no other material in nature. It is hard to think of Mochica effigy vessels as being derived from other materials.

The author becomes even more confused. "Since the cost of pottery is immensely reduced by capital, equipment and production in quantity, its development followed the growth of urban civilization. . . . its large-scale development awaited the introduction of town life in the early centers of civilization." Here, of course, the key is "development." If mass production is equated with "development" the author is correct, but esthetically speaking this is not necessarily true, as demonstrated by many New World ceramic developments. Quantitatively, he is not necessarily correct; the very earliest ceramic sites in southeast United States yield great quantities of pottery. There are many other generalizations which can be challenged. I imagine that his colleagues in Britain would not accept the statement that with the decline of the pottery industry, "which did not occur until the seventeenth century, wood, iron, and pewter had the opportunity to oust pottery from a large field of culinary and table uses." However real this "decline" may have been, it was nevertheless brief, for by the end of the 18th century English creamwares and whitewares dominated the tables of the Western world. In summary, there is much of interest in this chapter but I am wary of accepting sections dealing with material unfamiliar to me.

Volume II is composed of 21 chapters in five parts: Primary Production, Manufacture, Material Civilization, Transport and Practical Mechanics, and Chemistry. In this volume we move away from anthropology and archaeology. A primary use is made by the contributors of documentary sources. Lastly none of the contributors are those we normally are familiar with in anthropological reading, although a few contributed to the first volume. Although most of the articles are of considerable interest few are of direct value to New World archaeologists. Certain of them can be briefly mentioned for their background value. The first of these, *Leather* by John W. Waterer, presents the best brief picture of the treatment of skins that I am familiar with. The nature and qualities of hides and the major methods of treating them are concisely given. The variety of uses of skins in the Near East and Europe from late Paleolithic to Mediaeval times is shown.

Ceramics is covered in two chapters, the first by Gisela M. A. Richter going through Roman times, and Mediaeval ceramics by E. M. Jope. The first ably covers Greek and Roman pottery. Included is an ample but select bibliography. Also valuable is the essay on *Glass and Glazes* by D. B. Harden. In the chapter *Power*, R. J. Forbes offers an interesting concept of technological stages in terms of the nature of the "prime-mover," that is, source of power to work tools. He points out the increasing productivity of the five stages of human, animal, wind and water, steam, and atomic power respectively. *Machines* by Bertrand Gille is an excellent discussion of the fundamental nature of machinery and its development in classical times.

The volume is brought to a close with an epilogue, *East and West in Retrospect* by the senior editor. In this he succeeds in counterbalancing the emphasis given in the first two volumes which is traditional in European cultures — that is the derivation of the superior qualities of Western Civilization, in this case technology, from the classic Greeks and Romans. Singer points out the fallacy of this widely held picture in two ways. First, he emphasizes that in terms of technology the Greeks and Romans contributed little that was new, most of their skills having been taken over from earlier Near Eastern civilizations. He sums it up precisely: "The curve of technological expertness tends to dip rather than to rise with the advent of classical cultures."

Secondly, Singer makes acknowledgment to the great technological debt owed by the West to the East, not only in very early times but also in the post-Roman era. Until the Rennaissance, the West was deriving far more in technical skill, ideas and fine material objects from the Byzantine and Islamic world than they sent eastward. From fine woven silks to Arabic numbers the list was extensive. Even earlier, though, the extreme Far East, China in particular, contributed to Western technology in numerous ways. While it is impossible to document the spread of many items from East to West their earlier presence in China is well known.

By the end of the period covered in this volume, that is the close of the Middle Ages, the stream of ideas into the West virtually ceases. Technical history from then on is now a tale of Western developments moving out into the surrounding world. The *History of Technology*

is truly monumental in scope and achievement. Through its broad panel of contributors it brings together a scholarly picture beyond the capabilities of any one individual. It is a fundamental necessity in any anthropological library and will be the starting point for the development of many problems.

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The Exploration of Time. R. N. C. Bowen. Philosophical Library, New York, 1958. vii+143 pp., 40 figs. $6.00.

In 15 chapters this book reviews the methods used for dating rocks, fossils, and prehistoric events. A thorough discussion of the nature of time is followed by a description of each of the methods known for placing a particular event in time. After chapters which deal with the nature of the earth, the history of the science of dating, and concepts of time, the author takes up his discussion of the various methods of geochronology. These are classified according to the field of knowledge from which they are derived: physical and chemical, astrophysical and astronomical, botanical, zoological, geographical, archaeological, anthropological, and meteorological methods. A chapter entitled "Human remains and industries" attempts to relate the various discoveries of archaeology and physical anthropology. The application of geochronology to the study of human evolution is discussed in another chapter. Although Bowen's review of geochronology is brief, it is remarkably complete. Each of the geochronological methods is adequately described. In addition, examples are given in each case of how the method has been applied. Finally, the results of each method are reviewed critically and brought up to date. Thus the book is an excellent summary of the methods and findings of geochronology invaluable not only to the layman, but also (because the field is so vast) to the specialist in one of the particular methods of geochronology.

A few inaccuracies mar the work. For example, in the discussion of the radiocarbon dating method (p. 49) the statement is made that the Geiger counter has a range of 50,000 years. The Geiger counter, as used with the early solid-carbon method, had a maximum range of about 28,000 years. It is the proportional counter which has a range of 50,000 years. However, the proportional counter can be physically similar to the Geiger counter, although it is operated differently. It is used with the modern gas techniques, which employ carbondioxide, acetylene, or methane gas. On page 51, it is stated that radiocarbon dating has reversed the archaeological opinion that the Adena culture preceded the Hopewell in time. Early radiocarbon dates did seem to indicate that the sequence ought to be reversed, but the accumulation of more dates in subsequent years has shown that although the Adena and Hopewell cultures did overlap in time, Adena began at an earlier date than did Hopewell. Since the whole question has been so copiously discussed in print it is difficult to understand how the author missed the latest conclusions. The chapter on botanical methods deals mainly with dendrochronology and inadequately with the important techniques and discoveries of palynology. The cultural sequences in the Old World during the Paleolithic and Mesolithic are dealt with clearly and concisely, although Paleolithic industries in Asia are discussed without any reference to Movius' recent work. I would have welcomed, however, a fuller discussion of Early Man in the New World. The three brief paragraphs on the subject are confined to listing a few finds, all in western North America. In discussing the relationship of modern races to the various fossils the author states that it "is *generally* believed that the Chancelade race became the present day Eskimo" (p. 122), but in the same section he fails to mention Weidenreich's contention that modern Mongoloid characteristics are to be seen in the Sinanthropus remains.

The author does not include a bibliography, claiming that one would be out of place in a work of this sort. I could not disagree more. A few references giving the source of some of the ideas discussed and of some of the charts and maps would have added a great deal to the value of the book. The few defects of the book do not detract from the extremely careful and complete treatment the author has given to his subject, but merely reflect the enormous extent of that subject. No one man can be expected to be completely proficient and up-to-date in all the fields of geochronology. For this very reason the book is most welcome. It gives a brief, concise summary of the entire field, valuable to laymen and specialists alike and indispensible to the novice in geochronology.

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The Kensington Stone, A Mystery Solved. Erik Wahlgren. University of Wisconsin Press, Madison, 1958. xiv+228 pp. $5.00.

Thousands of pages have been written about the Kensington Stone. Therefore, the title of this brief (178 text pages) book may seem a bit presumptuous, but the author proves his case. He also proves that most of the thousands of pages would not have been written except for the persistence of one man: Hjalmar Rued Holand. In effect, this is not only an exposé of the Kensington fake, it is also a devastating analysis of the techniques used by Holand to keep the controversy alive for over 50 years. The Kensington Stone was "found" near Kensington, Minnesota, in 1898. On one face and one edge was an inscription of 222 characters "clearly related to Scandinavian runic alphabets of an early era" (p. 3). The stone was exhibited in Kensington, subsequently sent to Northwestern University for examination and copies of the inscription were sent to European and American scholars. Although all reports of their findings are not a matter of record, the majority concurred in declaring the inscription a modern hoax. The stone was returned to the original finder, a farmer named Olof Ohman, and the matter was forgotten.

Enter Holand, a young (35) Norwegian-American, who visited the Ohman farm in 1907 and acquired the stone. Then began a period of promotion, sparked by more than 20 publications by Holand, asserting the genuineness of the inscription against the arguments of experts in practically every field which could be brought to bear on the problem. So persuasive were Holand's arguments that many nonexperts and even some experts became convinced of the authenticity of the inscription. The originally declared fraud was rehabilitated to such an extent that a cast of the Kensington Stone is even now on exhibit in the Smithsonian Institution.

Erik Wahlgren (Professor of Scandinavian Languages, University of California, Los Angeles) effectively destroys the rickety structure of supposition, poor archaeology, inaccurate philology and semantics, and pure bombast that Holand and his supporters have erected. In a closely reasoned and heavily documented report (526 footnotes, 154 bibliographic references), Wahlgren demolishes Holand's contentions and exposes the imperfect scholarship on which they are based. After expounding the problem, the author's second step is to analyze the protagonists and antagonists. It is, perhaps, one of the most revealing chapters in the book, for it clearly shows how Holand has been able to gain support for a document which, from the beginning, had been declared a fraud by the experts who would be most capable of recognizing it as such. The philologists declare that, if the archaeologists support the find, they would be obliged in spite of reservations to accept the inscription. The archaeologists counter that if the inscription is genuine, they would have to accept the shaky archaeological evidence. Holand then puts them together, and says they both agree on the genuineness of the stone! The protagonists seldom are erudite in pertinent fields. In contrast, the antagonists are almost all men whose competence to analyze exactly this type of document is generally recognized, even, at times, by Holand. "To sum up (says Wahlgren), no scholar of eminence in the field of Scandinavian philology has called the Kensington inscription genuine" (p. 24).

The author proceeds to analyze the facts surrounding the discovery of the stone, which Holand has always claimed to be clear and irrefutable. On the contrary: the date of discovery, location of the site, and condition of the stone at time of discovery are all questionable. There is even some doubt of the validity of the commission of the Notary Public, who, in 1909 (11 years after the original "finding" of the stone and two years after its acquisition by Holand) recorded affidavits from persons concerned with the discovery! Geological evidence presented by the stone itself strongly suggests that the carving is recent: the inscription is scarcely weathered at all, and part of the inscription, cut into a calcite surface on a portion of the stone's face, does not show as much weathering as tombstones in New England graveyards. The geography of the area and the possible route of approach via Hudson Bay and the Nelson River come in for close scrutiny. Wahlgren proves, with devastating logic, that the route to the site was literally impossible for the supposed Swedes and Norwegians mentioned on the stone, and that the description of the site as inscribed in the document was completely consonant with what was visible in the 1890's, in spite of Holand's contentions to the contrary. Archaeological, geological, and geographical information, on which Holand puts so much weight to overbalance the damaging philological contentions, is proved to be highly suspect.

In philology and semantics, Wahlgren's sure hand parries and defeats Holand with every thrust. He successfully proves that the phraseology of the inscription is modern, that the grammar and verbiage is of the late 19th century, and that the orthography is a weird mixture of runic symbols from the 800's to the 1800's plus unique forms. Moreover, he adduces much evidence from books owned by the farmer Olof Ohman about the way such a peculiar scramble of letters, words and phrases could have been concocted. Among the most telling evidences of fraud are the numerals on the stone: although "runic" in appearance, they are based on the Arabic system of numeration! As Wahlgren points out (p. 120), this is comparable to giving the date 1362 in Roman numerals as IIIIVIII (I–III–VI–II) in place of the correct MCCCLXII!

Careful analysis of the extant "copies" of the inscription by the author turns up some other rather peculiar circumstances, to say the least. The copies have spellings of words which are alternates for those appearing on the stone. These variant versions seem to have been circulated to the experts shortly after the stone was originally discovered, and so were made by individuals (presumably) untutored in the writing of runes. Yet, these changes do not affect the meanings of the words, in spite of the fact that the symbols are very different. The inescapable conclusion is that someone connected with the original discovery *did* understand runes, and that these variants either represent preliminary drafts for the inscription, or deliberate frauds in copying to confuse the experts.

In the final chapters of his book, Wahlgren amplifies the contention that the inscription was concocted as a deliberate hoax (although he refuses to name the hoaxer), and that it contains numerical permutations — a sort of "playing with numbers" — which was much in fashion around the turn of the century. This part of Wahlgren's thesis is, perhaps, not quite as convincing as his analysis of the problem itself. However, he makes a good case for a more educated climate in which the hoax could have been perpetrated than has previously been allowed. In so doing, he has effectively parried the contention that the inscription was intellectually beyond the scope of anyone in the region of Kensington in 1898.

The Kensington Stone died once, shortly after its birth. Its ghost was conjured back to life by Holand, and for 50 years has tormented anthropologists, historians, and philologists. Wahlgren has at last laid this uneasy spirit to rest, this time, let us hope, forever.

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Tribes that Slumber: Indian Tribes in the Tennessee Region. T. M. N. Lewis and Madeline Kneberg. University of Tennessee Press, Knoxville, 1958. xi + 196 pp., illus. $3.75.

Kneberg and Lewis have produced a unique book. It draws on the tremendous store of field notes, reports, specimens, and special-purpose files which have become available to them through their activities in Tennessee archaeology from the time of the TVA salvage programs until the present. A very attractive binding and the fine illustrations, mostly drawings by Madeline Kneberg, set an unusually high standard of appearance. The book was written for "students, for amateur archaeologists, and for all other persons with curiosity about the Indians" (p. v). In my opinion, its content, style, and organization are extremely well suited for the second two categories. The student may find it over-tantalizing in spots.

There are ten chapters, arranged in chronological order. They cover the prehistory of the Tennessee area from the paleo-Indian period ("Nomadic Hunters of the Ice Age") to Historic Cherokee ("Principal People" and "The Sacred Seven"). The Archaic, Early Woodland, and Middle Woodland or Burial Mound periods are each covered in a chapter. A general chapter on "The Age of Temple Mounds" introduces the Mississippian periods, which are further developed in "People of One Fire," the Dallas culture; a chapter on the Busk and the Southern Cult, and one in the Mouse Creek Culture, "Children of the Sun."

Perhaps the most significant innovation in this book is the continuous, and, I think, largely successful, effort to interpret data and revitalize the archaeological cultures and their interplay through time and space. Description is not slighted, but is held down to the amount and kind necessary for cultural reconstruction. The general reader will not, in this book, fall into the semantic trap of believing that he has learned something useful by memorizing a list of pottery or projectile point type names. Technical jargon, a most useful shorthand for communication among specialists, is virtually eliminated. Description, and more importantly, interpretation, are not slighted at all. It is to be hoped that this approach to semi-popular presentation, in which selected description of the concrete data of archaeological wholes is interpreted through thoughtful application of ethnological fact, will be used as a model by other writers for other regions.

This technique for popular presentation makes a critical review for a technical journal difficult. Southeastern archaeologists will disagree with reconstruction and interpretation on all levels. Since full documentation is not, and should not be, present in a book of this type, differences of opinion are possible. They will extend from the significance of a particular pottery type in a particular context through the wholesale acceptance of migration to account for observed culture change to the identification of some of the later complexes with specific cultures. A few of the items I question are:

The replacement of the Archaic population by a newly migrated Early Woodland population.

The Temple Mound Period as the result of the spread of people who were mostly Caddoan and Muskhogean.

The existence of a pre-Columbian Creek Confederacy, with political power over a huge area. On the other hand, this book includes the first recognition I have seen printed that towns and confederacies, not tribes, were the vital socio-political units in the temple mound periods. The bare existence of major ceremonial centers implies this.

The identification of the Dallas culture with Creek and Mouse Creek with Yuchi. These are quite possible, but I doubt that the theories have been sufficiently validated to warrant their usage in extensive reconstructions.

These points, and others, are difficult to argue because of the great wealth of information used in interpretation which is thus far available, in organized form, only to the authors. Certainly this book is not the place for technical description of the several Early Woodland phases mentioned, of Harmons Creek sites and multiple-mound, walled, and terraced ceremonial centers, of the Dallas site, or of many other archaeological units. Without these data, the validity of many interpretative generalizations may certainly be doubted, but cannot be argued against very strongly. The final chapters on the Cherokee, "Principal People" and "The Sacred Seven," provide the best summary descriptions to date, and the only readily available ones, on this important culture. As such they should have considerable utility.

This book can certainly be highly recommended to the general reader, the audience for whom it was written, as a good general account of the high spots in 10,000 years of Tennessee prehistory and early history. This might be qualified by emphasizing that some part of the material presented is opinion, and may well be changed by further work. But, it is certain that the opinions are those of the best qualified people. The researcher, or the advanced student generally, will not find the book too useful as a tool in his studies. The teacher will enjoy reading it, and certainly can use it to develop enthusiasm and healthy curiosity in beginning students. The lack of technical description and references makes it difficult to find required facts, or, in spots, to sort out fact from theory. This is all to the good. A tremendous audience exists which wants to learn American prehistory, and which deserves the opportunity to learn. It is high time that someone wrote for them, and this book is a fine start. The specialist may hope that further reports of the quality of "Hiwassee Island" will be issued for his purposes.

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An Introduction to Hudson Valley Prehistory. William A. Ritchie. New York State Museum and Science Service, Bulletin 367, Albany, 1958. 112 pp., 5 figs., 32 pls. $1.50.

This report, called preliminary by Ritchie, is in fact the definitive recording of basic archaeological data now

available on the Hudson valley area. It is no doubt preliminary to expanded and more detailed analyses which are now in the making. The format of this tightly written bulletin is straightforward. After a one-page preface, the meat of the report is presented in a series of site descriptions. Seven Hudson valley excavations are ably described and illustrated. Interpretations or conclusions are drawn from individual site descriptions and these are arranged to build upon each other. Two of the sites (Harris and Lotus Point) were excavated by Ritchie, five of them (River, Hennessy, Bannerman, South Cruger Island, and Snook Hill) by various "amateurs, whose interest in the potential historical significance of their sites led them to request professional field guidance in the collection of their data and to make their findings available to the writer for study, analysis and publication" (p. 8).

As might be expected, Ritchie feels most certain of his conclusions when dealing with his own excavation work. He has, however, wrung considerable information from the evidence excavated by others. All of these data are synthesized in the general conclusions where two other areas of evidence are introduced: fluted and Steubenville projectile point distributions in the Hudson valley. The former is used as evidence for the hypothesized earliest occupation; the latter for an occupation transitional to the Early Archaic or Lamoka-like complex which is amply evidenced in the sites described in this report.

In many ways the Lotus Point excavations seem the most significant of the group. "Here the cultural-physical stratigraphic correlation indicates the reality of an underlying slender point assemblage, followed by a Vosburg complex which had absorbed it, then a fishtail point and steatite horizon and, finally and successively, an older pottery horizon with certain lithic elements of preceding levels and a recent, late prehistoric ceramic and triangular point complex. . . ." (p. 100). This sounds like the best and longest stratigraphic sequence from any New York state site, and as such the illustrations (Pls. 8, 9, 10) are a disappointment. Field profile photos are inadequate, but the accompanying site map and drawn profile are convincingly clear cut.

By way of constructive criticism of a very competent and useful report, I suggest that tabular rather than narrative presentation of site artifact inventories would facilitate the use of this study by others for quantitative comparative purposes. Ritchie uses binomial terms for projectile point types, such as Vosburg Corner-Notched, Lamoka Stemmed, without previous definition or systematic description. This he states will be done later. Ritchie also used the term "tradition" in both text and a graphic synthesis, with minimal definition and description. While the purpose and intent are commendable, usefulness and clarity demand more adequate treatment than this. No doubt such treatment will appear in his anticipated resynthesis of New York archaeology.

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Prehistoric Indian Settlements of the Changing Mississippi River Delta. WILLIAM G. MCINTIRE. Louisiana State University Studies, Coastal Studies Series, No. 1, Baton Rouge, 1958. x+127 pp., 33 figs., 13 pls. $5.00.

This study was conducted under the auspices of the Office of Naval Research through the School of Geology, Louisiana State University. The report is significant to archaeologists, although the author states that it is not intended to be an archaeological report, because it extends the knowledge of cultural complexes across the Louisiana coast and uses pottery as a time marker of geological changes on the coastal beaches and in the deltaic development of the Mississippi River. The author's thesis is that prehistoric man "followed the master stream, and his settlement concentrations in one area and the absence of them in another point out regions that were habitable during a particular time period. By mapping the initial occupation sites for each period . . . it is possible to discern the relative pattern of the progressive development of the deltaic plain."

The study covered the entire Louisiana coast to a northern limit of approximately 30°05′ latitude, largely on natural levees, active and stranded beaches, and uplifts around salt domes. More than 500 sites were listed, from which more than 40,000 sherds were gathered. One hundred fifty sites yielded the chosen minimum of 50 sherds and were used for classification; the results of the paper were based on decorated sherds alone. The kinds of sites included earth mounds, shell mounds, shell middens, black-earth middens, and beach deposits. Previous surveys in this area are described and credit is given particularly to Kniffen, who first attempted the correlation of physiographic features with Indian pottery in the survey area. Due recognition is also given to the former Louisiana State University group of archaeologists, Ford, Willey, and Quimby, for the establishment of culture chronology and pottery typology of the lower Mississippi.

Although surface collections of sherds constitute the major study material, other items were assayed in reaching the final conclusions. These included radiocarbon dates, bore samples of mound and midden sites, establishment of the physiographic base, changes in shell types which reflect alterations in water salinity, site subsidence — which varied from 0 to 10 feet across the coast but reached a depth of 20 feet below present water level at one Lake Pontchartrain site. An extensive, although admittedly not exhaustive, description of climatic conditions, plants, animals, and marine life of the area is included, with evidences of their importance to the aborigines.

The 46 pottery types used as time markers are from the Tchefuncte–Marksville–Troyville–Coles Creek–Plaquemine–Natchez sequence of the lower valley, covering a period of nearly 2000 years. Correlations with physiographic features are discussed and mapped for each culture period. The author recognizes the elimination of Archaic sites to be one of the limitations of using pottery as a study tool. No Archaic sites were identified during

the survey but it is anticipated that more extensive research will establish these on the more stable beaches (cheniers) or Pleistocene terraces in the western part of the state. In this connection, it appears unrealistic to me, in the light of studies since 1945, to speak of the Copell site as "early Tchefuncte" because materials found at this site are closely related to non-pottery cultural material of the Tchefuncte period. Tchefuncte, like other early pottery cultures, has little except pottery to differentiate it from the antecedent Archaic; it seems logical, therefore, to consider the non-pottery Copell site as Archaic.

Initial occupations during the Tchefuncte period form two widely separated clusters, around Lake Pontchartrain in the east, and on stranded beaches and Pleistocene terraces in the west. The hiatus of occupational sites in the central portion of the coast is attributed to its location on the river flood plain, with possible subsidence and destruction or burial of Tchefuncte sites by later stream action. The intervening Lafayette site, described in the original Tchefuncte report, is north of the survey area and hence is not mentioned by the author. Tchefuncte occupations offer little evidence about the location of the contemporary Mississippi flow pattern, but the eastern sites contribute some evidence that Lakes Borgne and Pontchartrain were in existence then. An interesting observation, not commented on by the author, is the demonstration in Plate 13 that the eastern sites, the original nidus of Tchefuncte, with one exception show no occupation beyond Marksville times, while 20 of the 22 western sites show occupation from Tchefuncte to Coles Creek or Plaquemine times. The western sites will also contribute effigy mounds as a Tchefuncte trait, if the tentative identification of the alligator-effigy shell mounds with this period is borne out by future investigation.

In subsequent periods there is evidence of progressive habitation of new sites, with 20 to 44 initial occupations recorded and mapped for each of the culture periods from Marksville through Plaquemine. These initial occupations in the various relict subdeltas of the Mississippi become useful in plotting the sequence of the master stream migrations after it deserted the Teche-Mississippi prior to Marksville times. Particularly significant are the association of initial Marksville sites with the Grand River and Early St. Bernard subdeltas, with some indication that the latter extended out to the Chandeleur Islands; of Troyville with the Grand River Basin, with another cluster of sites in Terrebonne Parish which possibly relate to the Teche-Mississippi or the subsequent Red-Boeuf drainages, and with the Baritaria-Bayou Cutler system; of Coles Creek with Bayou Terre aux Boeufs; and of Plaquemine with the Lafourche-Mississippi, late St. Bernard and Plaquemine subdeltas. A check on the author's thesis and on the general validity of the culture periods is afforded by the cheniers of the western area, where good correlation is noted between the initial cultural occupations and the geologically presumed ages and locations of the beaches.

An admitted weakness of the material is the dependence upon a single pottery type as the major criterion in both the Troyville and Coles Creek periods. The distribution of the two types, French Fork Incised and Check Stamped, is plotted separately. Significantly, the author states that "the lack of other diagnostic types of pottery and the absence of temple mounds in the form described for the Coles Creek period seem to indicate that in the coastal area the Troyville and Coles Creek periods cannot be differentiated on the basis of types used in the lower Mississippi Valley." Since the peak of French Fork frequencies at the Greenhouse site coincided with the line of demarcation between Troyville and Coles Creek, this pottery type cannot justifiably be chosen as an indicator of Troyville any more than of Coles Creek. Also, the relatively high incidence of Check Stamped pottery from the survey sites, compared to the low frequency and brief duration of this type in Coles Creek sites of central Louisiana, needs further study before the validity of this pottery type as a time indicator can be accepted.

Beyond these weaknesses, which tend to confirm the difficulties which students away from the central Louisiana area have faced in recognizing distinctive Troyville pottery and accepting the interposition of this period between Marksville and Coles Creek, one must be critical of the sampling methods used in this study, even though the conclusions generally seem valid. This is the third major attempt to correlate pottery types and Mississippi stream channels. Kniffen's study was localized and suggested the correlations which form the basis of the present study. Phillips, Ford, and Griffin related habitation to relict channels in the higher valley. They cautiously presented their results as an experiment in correlation sufficiently suggestive to warrant further study. They especially indicated that initial occupation of a previous river channel may occur and/or habitation may continue long after it ceased to be the active river, so that habitation evidences are more important as minimal than as maximal indicators. They add: "It is hardly necessary to add that considerably more and better field work has got to be done on the problem before it can be regarded as anything more than a working hypothesis."

McIntire exhibits more assured reliance on the validity of this thesis; the exactness of the major channel-habitation relationship implied in the present study was not borne out in the upper valley. In attempting either to prove or apply this thesis, adequate sampling must be assured, and in my opinion the present sampling is not adequate for the individual site alignments. Reliance on surface collections is tricky in an area where prolonged occupation is the rule and where the deeper levels of sites are often covered by stream action. Moreover, it is doubtful that a minimum of 50 sherds is adequate to establish initial occupation of a site, especially since published reports show that lower Mississippi pottery, in all periods, has only 13 to 17 percent of the sherds decorated. It would have been more acceptable had a minimum of *decorated* sherds been set and at least the number of sherds on which sites were aligned should have been stated in Plate 13. It is especially disturbing to note that 50 of the 150 sites are represented by only one to three pottery types. Twenty-two of the 38 listed Marksville

period sites are placed in this category on the basis of Marksville Incised sherds alone, a type which is not highly diagnostic from sherd study.

Despite this major criticism and a few editorial slips ("Encised" in Figs. 30, 32), this is a well written document which is important to students of several disciplines. It is readable and well illustrated with clear photographs and excellent charts and maps. The correlation between cultural remains and the physiographic setting, strengthened by radiocarbon determinations and other collateral evidence, is adequate to encourage similar use of cultural remains elsewhere. Students of prehistory will anticipate the promised report on the complete archaeological studies of the surveyed area.

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Archeological Notes on Stansbury Island. SYDNEY J. S. JAMESON. University of Utah, Anthropological Papers, No. 34, Salt Lake City, 1958. vi+48 pp., 33 figs., 2 tables. $2.00.

Stansbury Island is situated in Great Salt Lake near the southern shore. The report reviewed here describes archaeological remains recovered from two caves in the southern part of the island and petroglyph sites near these caves. The work was done in 1947 and earlier, and was written as part of a master's thesis submitted in 1948. The published report was extracted from this thesis by the editor of the series, apparently without the aid of the author. Since the paper was written ten years ago and was not revised by the author or by the editor in the light of more recent publications on neighboring sites, it naturally strikes the reader as being out of date, but it would perhaps be unfair to criticize a paper for not being what it does not intend to be.

The caves are called Stansbury I and Stansbury II. Stansbury I had two main levels of human occupation, but all remains recovered from these two levels are attributed to the Black Rock culture with the exception of a few items from near the surface which may be Shoshone. The artifacts recovered include about seven projectile points, two drills, a shaft smoother, three bone awls, two pieces of fiberwork, one wedge-shaped piece of bone, two disc-shaped stone objects, an unfinished gorget (?), a possible scapula saw, and an unreported number of stone knives, scrapers, manos, and metates.

Jameson attributes the cultural debris in Stansbury II to four different cultures: Bonneville, Deadman, Black Rock, and Puebloid. The presumed Bonneville materials consist of chips and flakes from the lower deposits. These deposits also include ash and charcoal. The Deadman level produced about eight points, a barbed bone for a fishhook (?), a large chalcedony scraper, two shell pendants, and an unreported number of bone awls, flat metates, and manos. The Black Rock level produced about 23 points, one shaft smoother, one perforated stone disc, one shale pendant, one human burial and a number of disarticulated human bones, and an unreported number of metates. The Puebloid level produced 148 sherds of Great Salt Lake Plain Gray (subtype Knolls), about 21 points, one clay figurine, three etched stones, three shaft smoothers, two (?) bone beads, and an unreported number of manos and metates. One piece of coiled basketry is reported from near the surface. Four drills were found in Stansbury II, but their depth and cultural affiliation are not given.

Cultural affiliation is made primarily on the basis of point types and the presence or absence of pottery. The sample of points is small, however, and quite diverse in form, making such affiliation difficult to determine. The report is sketchy on quantification, and certain categories of artifacts are given very cavalier treatment. Bone awls, in particular, suffer from lack of description. No suggestion is made as to the kind of shell from which the several shell pendants were made. No mention is made of faunal remains from either cave. Some measurements and indices of two crania are reported, but the measurements of the post cranial skeletal material are not presented.

Both caves produce material similar to that recovered from Danger Cave. Stansbury II is actually at the same elevation as Danger Cave, and therefore must have undergone a similar geologic history. The specialist will want to compare the material from the two areas. While this report has many defects, it is still a welcome addition to the increasing number of Great Basin site reports.

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The Topanga Culture, Final Report on Excavations, 1948. A. E. TREGANZA AND A. BIERMAN. University of California, Anthropological Records, Vol. 20, No. 2, Berkeley and Los Angeles, 1958. 42 pp., 6 figs., 8 pls., 8 tables, 3 maps. $1.00.

The Topanga culture of southern California is best represented by two sites, LAn–1 (Tank site) and LAn–2, near Los Angeles. The former appears to be one of the oldest habitation sites in California and is believed by some archaeologists to be as old as the Folsom complex and older than Cochise. Features at the Tank site which indicate an early age for the Topanga culture are: a highly indurated soil; crude, often heavily patinated core and percussion flaked implements; extended burials; and the great predominance of manos and milling stones over mortars and pestles. The Paleolithic-like choppers, scrapers, and hammerstones from the Topanga sites are most similar to those from reputedly ancient San Dieguito, La Jolla, and Mohave cultures of San Diego County, California. Recently three San Diego coastal sites, which appear to be typologically later than Topanga, were dated by radiocarbon assay at 7000 years B.P. Although additional evidence supports a considerable antiquity for Topanga, absolute dates obtained directly from the LAn–1 and LAn–2 sites are needed to establish the chronological position of this early culture.

The publication reviewed here is Treganza's second report on the Topanga culture and describes the work accomplished in the 1948 season (results of the 1947 excavation at the Tank Site were published in 1950 by Treganza and Malamud). In 1948 a survey of Topanga Canyon revealed nine additional sites yielding artifacts similar to those of the Topanga culture. However, none of these sites was excavated. Instead, emphasis was placed upon obtaining a larger inventory of artifacts, burials, and features from LAn–1; and carrying out exploratory excavations at site LAn–2, some 350 yards west of LAn–1. At the close of the season's work, two phases of the Topanga culture were distinguished. Phase I is typified by the lower levels of the large Tank site (LAn–1) which Treganza tentatively dates between 8000 and 4000 B.C. Characteristics of Phase I include extended burials with head oriented south, reburial of long bones under metates, fractional burial, large percussion-flaked projectile points and blades, and dominance of manos and metates over mortars and pestles. Phase II is based upon limited excavation of the LAn–2 site which Treganza suggests may date from 5000 to 2500 B.C. Phase II has flexed burials only, small pressure-flaked projectile points, and shows an increase in mortars and pestles. The same kinds of crude choppers and scrapers are typical of both phases.

At the end of the report, Treganza suggests a chronology for early California milling and hunting cultures. He indicates that such cultures as San Dieguito, Topanga, and Oak Grove developed from an earlier culture, possibly Lake Mohave, in the Mohave-Colorado desert region. However, he does not discuss his reasons for placing the various cultures at different points in time. For example, it would be useful to know why Big Tujunga Wash is assigned a date of between 3000 and 4000 B.C. when there is considerable evidence from the site, including Hohokam pottery dated between the 7th and 9th centuries of the Christian era, which suggests a relatively late occupation.

In general, the description of artifacts, which comprises the bulk of this report, is concise and well presented. Numerous tables condense the data and thereby facilitate comprehension of the total assemblage. The illustrations are a useful supplement to the text. Photographs of the projectile points and the drawings of the scrapers are particularly helpful in distinguishing artifact types. Additional illustrations and data pertinent to a fuller understanding of this early culture can be found in the 1950 Topanga report. Treganza and Bierman have done an excellent job of defining the Topanga culture.

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Excavations in Mancos Canyon, Colorado. Erik K. Reed. Appendices by T. D. Stewart, E. T. Hall, R. W. Gilmore, Herbert Friedmann, and V. H. Jones. University of Utah, Anthropological Papers, No. 35, Salt Lake City, 1958. xiii+224 pp., frontis., 62 figs., 2 tables. $4.00.

The quantity of unpublished archaeological documents buried in the files of various institutions must number in the hundreds. The data thus entombed may be well known to a few archaeologists, known by hearsay to others, but totally unknown to a majority. Yet, the widespread dissemination of these data is necessary, both to complete the responsibility of the excavator, and to make them available to those who would use them in the reconstruction of the past. The University of Utah is to be congratulated for publishing Reed's manuscript and thus making another dent in the backlog of long awaited reports. *Excavations in Mancos Canyon, Colorado* is published in the standard University of Utah format, by offset lithography. Illustrations are generally of good quality and are well reproduced. There are a few typographical errors but they do not appreciably mar the report.

Foreword and Preface detail the history of this publication, from the field work in 1942, its presentation as Reed's doctoral dissertation in 1944, the revisions through 1947, to final publication in 1958. The project and the procedures employed in salvage excavations in five sites and survey in 24 additional open sites are discussed in an introductory chapter. Previous work in the Mancos Canyon area is briefly reviewed, as are the Pecos classification, as used by Reed, and Southwestern archaeology. Chapter 2 gives a synopsis of each site excavated in terms of structure, physiographic situation, pottery, stratigraphy, and artifacts. Summary data on the accompanying site survey are followed by an analysis of site distribution in relation to regional physiography and the outcropping of the impervious Mancos shale. This valuable and provocative section should lead to a greater consideration by other archaeologists of the physiographic relationships of their sites and areas.

Architecture is next described by means of an expanded outline form closely integrated with plans and photographs. The functional attributes of structural elements, such as the weight-transmitting characteristics of wall construction, are more fully treated than usual. With the exception of the Basket Maker III component at Site 3, all the units are Mancos or Mesa Verde focus in time. Although no excavations were undertaken in such sites, Reed discusses towers, twin-kiva pueblos, and great kivas, the likelihood that these features are primarily ceremonial in nature, and their temporal and cultural relationships in the Anasazi area.

Burials are briefly treated in Chapter 4 in terms of location, position, and accompaniments. Burial practices in the Mancos Canyon ruins, flexed or semi-flexed, as opposed to extended inhumation, are related to the general Southwestern picture. Reed reviews various theories concerning the continuity of Anasazi population and stresses the importance of lambdoid deformation as a cultural diagnostic, a note which is also sounded in Stewart's appendix on the skeletal material.

A chapter on pottery, which begins with a discussion of taxonomic problems, both in general and as applied specifically in Southwestern archaeology, gives the classification of the pottery of southwestern Colorado as of

1942. Then follows an engrossing study of the difficulties of applying an abstract taxonomy to a body of materials. His treatment of the supposed characteristics and relationships of La Plata, Piedra, Mancos, McElmo, and Mesa Verde black-on-white pottery types clearly points up the confusion existing in this terminology. Even if he has not provided solutions to the problems raised, he has supplied a background for the recent revision of the Mesa Verde area ceramic typology by Abel (1955), a revision which itself now needs to be thoroughly tested in the field and laboratory. Reed also provides some thought provoking discussion of the relationships of Mesa Verde and Chaco pottery and of the San Juan orange (or red) wares and Mogollon types.

Chapters 6, 7, and 8 are concerned respectively with the description of bone and stone tools, and ornaments.

Cultural Categories, Chapter 9, is an interesting excursis into the functional grouping and interpretation of data from the various sites. Structural and portable artifacts have been grouped and discussed in terms of subsistence, shelter, costume and personal appearance, weapons, religion and art, and unclassified artifacts, based on direct and inferential evidence.

The final chapter is devoted to such general topics as chronology and period terminology, and distribution of sites and physiographic considerations as related to the abandonment of the area. Since Anasazi ruins occur only on the second terrace of the Mancos, Reed concludes that this terrace formed the banks of the Mancos River until about A.D. 1300. Thus, the erosion of this terrace would correspond with, and was perhaps a contributing factor in, the abandonment of the Mesa Verde area. He further concludes that the modern southern Tewa or Tano represent the descendants of the Mesa Verde people.

Five appendices contain a list of specimens catalogued: The Skeletal Materials, by T. D. Stewart; Dendrochronological Notes, by E. T. Hall, Jr.; Vegetal Remains, by Volney H. Jones; and Faunal Remains, by R. W. Gilmore and H. Friedmann, with a discussion by Reed of the significance and distribution of the various animals in Southwestern archaeological sites. Three bibliographies complete the monograph.

This is a rambling and discursive report. It is also a very good report. Although some of the interpretative material has suffered in the interim between writing and publication, the raw data are as timely now as when freshly dug, and go a long way toward filling a gap in our knowledge of southwestern Colorado archaeology.

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The Reeve Ruin of Southeastern Arizona: A Study of Prehistoric Western Pueblo Migration into the Middle San Pedro Valley. CHARLES C. DI PESO. Collaborator, HUGH C. CUTLER. Amerind Foundation, No. 8, Dragoon, 1958. x+189 pp., 26 figs., 82 pls. $7.50.

The Amerind Foundation has been studying the archaeology of southeastern Arizona for the past two decades. This report covers part of their last excavation in the San Pedro Valley of southeastern Arizona. In 1956 the Amerind staff excavated three ruins near Redington, Arizona: the Bidegain Mound, the Davis Ruin, and the Reeve Ruin. This report, as the title suggests, deals primarily with the archaeology of the Reeve Ruin, although the introduction and some of the plates and figures certainly give the reader the impression that all three ruins will be discussed more or less at length.

In Chapter 1, Di Peso explains his concept of what happened in prehistoric times in southeastern Arizona. As in his previous report, he uses the terms "Ootam" when discussing the archaeology of the people he believes ancestral to the Pima-Papago, and "Pima-Papago-Ootam" when discussing the early historic and historic Pima-Papago. The well known archaeological term Hohokam is used in hyphenated form, "Hohokam-intrusive period," and refers to a Mexican group which Di Peso thinks migrated into southern Arizona and dominated the Ootam around A.D. 700–800. He believes that between 1250 and 1300, the Ootam reasserted themselves, drove the Hohokam out, and then continued to live in their old land, watched the comings and goings of other groups, and were influenced by the ideas from other areas, especially the Western Pueblo and the western Mexican areas. This report presents the archaeological evidence of the migration of a Western Pueblo people who built the Reeve Ruin on the San Pedro River, lived there long enough to leave an accumulation of trash and to do some remodeling of their pueblo in true puebloan style, and finally departed at an unknown date for some as yet unknown area.

Chapter 2 deals with the architecture; Chapter 3 with the arts and crafts, including ceramics, stone, "socio-religious objects" (concretions and other problematical objects), ornaments, and bone tools. In all of these subjects the author first discusses the implication of his archaeological finding and then describes in minute detail (and print) the material he found. This reverses the usual pattern of archaeological reporting. It has the advantage of allowing the busy reader to skip the small print and the disadvantage of making the interested reader continually turn ahead to the charts, figures, plates, and small print to find out why the author has come to a certain conclusion.

Chapter 4, entitled Trade Pottery, includes a breakdown of the ceramics found at Bidegain Ruin (Fig. 23), a tentative sequence of the Santa Cruz Red-on-brown series in the San Pedro Valley (Fig. 24), and a description of the trade pottery. I cannot see why this chapter could not have been part of Chapter 3 (Part 1 — ceramics), nor why Figure 23 was included at all.

In Chapter 5 Di Peso discusses Pueblo-Ootam contacts. He feels that the archaeological evidence from the Reeve Ruin and other sites, ethnological evidence including native Pima-Papago and Hopi myths, and historical reports, all suggest Pima–Papago–Hopi (and possibly Zuni)

cultural connections. Historic Spanish reports (Velarde) mention that the Pima-Speaking Sobaipuri who occupied the lower San Pedro Valley in the vicinity of Reeve Ruin had close "Hopi" connections and were different in many respects from the more western Pima-speaking peoples. The author suggests that this difference might well be the result of an eastern Pima–Papago–Ootam amalgamation with a Western Pueblo group such as the one that occupied the Reeve Ruin, and I am inclined to think he is right. The period of sporadic Spanish contacts in the 16th century is discussed in Chapter 6. Di Peso cannot come to any conclusion as to the possibility that the Reeve Ruin was still occupied in the mid-1500's. There is some suggestion, he points out, that De Niza and Diaz may have seen pueblo villages such as the Reeve Ruin in the lower San Pedro, but nothing is certain. Spanish descriptions are vague and cannot be used to date the late occupancy of Western Pueblo sites in this area.

This report is a contribution to the prehistoric story of southeastern Arizona. But it seems hastily compiled and not as well organized as could be desired. There are unneeded plates, duplication of material shown in plates and figures, and puzzling references to the material from sites other than the Reeve site. Nevertheless, important new archaeological evidence is presented that seems to help explain why the Sobaipuri of the San Pedro Valley in early historic times differed culturally from their Pima-speaking relatives to the southwest.

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Excavations, 1940, at University Indian Ruin. Julian D. Hayden. Collaborators, 1954: Edward B. Danson and Robert M. Wallace. Southwestern Monuments Association, Technical Series Vol. 5, Gila Pueblo, Globe, Arizona, 1957. xii + 232 pp., 8 figs., 49 illus. $4.00.

The University Indian Ruin is located seven miles northeast of Tucson, Arizona. For a number of years it has been used by the University of Arizona as a training ground for student archaeologists because of its proximity and because it contains an interesting group of architectural features such as pit houses, single-storied adobe structures, and several large artificial mounds. This eleven-acre patch of ruin is believed by Hayden to have been occupied from about A.D. 1200 to 1400, through the Soho and Civano phases (called locally the Tanque Verde and Tucson phases) of the Classic period of the Hohokam sequence, and to have had strong Salado affiliations.

In 1940 Hayden excavated a village and one of the large mounds located on this site. The work was done with the aid of the Civilian Conservation Corps, under the direction of the National Park Service. The report under review, which was completed in 1942 and added to in 1954, covers these excavations and attempts to draw together data gathered at the ruin over the years by other students. Although the latter objective is only partially achieved because of the shortcomings of the record, this report is important because of its account of the village and because it is the first to give a detailed description of a mound structure in the Gila-Salt and Tucson drainages. Hayden has made a skillful architectural analysis, and his descriptions of mound, wall, and roof construction are informative.

The monograph also includes an adequate section on stone artifacts, scanty reports on burial modes, vegetal and faunal remains, and a very useful discussion of salt erosion describing its effect on adobe construction. Hayden's section on ceramics does not appear to be well coordinated with the appendices written by Danson and Wallace. The various sections are well illustrated, but it is disconcerting to come upon plates in which the individual cuts are oriented at right angles to one another (Pls. 7, 10, 17, 19) or have their captions at right angles to the pictures (Pls. 4, 8, 18, 20).

Wallace's work on the petrographic analysis of ceramics (pp. 209–19) inspires exciting speculations, although it appears that the number of thin sections utilized in the study was insufficient to be conclusive. Further, I was somewhat confused by the charts presented in this section, (Pls. 43–46) which have their captions scrambled. Danson's descriptive analysis of the pottery types encountered at the site is clear and concise. He covers three long-known but previously unpublished pottery types — Pantano Red-on-Brown, Tanque Verde Red-on-Brown, and Tucson Polychrome — and gives a new description of Gila Plain. His speculations regarding the Kayenta affiliations of Tucson Polychrome (p. 226) are most interesting and it is hoped that his thoughts will lead to further research along these lines.

The major portion of Hayden's conclusions (pp. 177–201) deals with a Hohokam-Salado historical reconstruction in which he draws on his wide field experience at such sites as Casa Grande, Grewe, Pueblo Grande, and Snaketown. In his discussion he covers a number of important Hohokam-Salado sites that have not been fully reported on. His handling of the Hohokam-Salado problem reflects the opinions and theories current in 1942, and his conclusions of that date have been allowed to stand.

Hayden concludes that the Hohokam pit houses at the University Indian Ruin were supplanted at the end of the Tanque Verde phase (the earlier of two phases at the site) by contiguous pit houses with massive surface walls. He believes that this shift was due to Salado influence, which reached the Tucson area about A.D. 1300, and that the introduction soon after of a complex of "Salado" traits points to the occupation of the Tucson area by these Pueblo people. The existence side by side in separate dwelling units at the University Ruin of the new Salado traits (type of architecture, inhumation, Gila and Tucson polychromes) with the older Hohokam traits (cremation, red-on-brown pottery) indicates to Hayden that ". . . two ethnic groups here lived amicably side by side. . . ." He goes on to say that throughout most of the 14th century the "Hohokam continued to live on beside the Saladoans,

and their culture was continued with little interchange of traits, other than pottery, with their Salado neighbors." I have criticized this conception of Salado as a cultural entity and the characterization of this strange culture contact situation and other students working in the field have seriously questioned them.

In his 1954 comments (pp. 200–1) Hayden discusses briefly Schroeder's theory that the late culture of the Gila-Salt drainage was a blend of Hohokam and Sinagua rather than Salado. He also suggests new relationships of the University Ruin with Sobaipuri on the one hand and Palo Parado near Tumacacori on the other. But he makes no real attempt to bring his conclusions about the University Ruin and the Salado problem up to date, or to list in the bibliography the pertinent publications that appeared since 1942; for example, Haury's on Ventana Cave (1954), Schroeder's on ceramics and architecture of the Gila-Salt (1952, 1953), and Tuthill's on the Tres Alamos site (1947), and his notes on the Dragoon complex (1950).

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Middle American Anthropology. Special Symposium of the American Anthropological Association. Assembled by GORDON R. WILLEY, EVON Z. VOGT, AND ANGEL PALERM. Pan American Union, Social Science Monographs, No. 5, Washington, 1958. viii+60 pp. $0.50.

The four papers with accompanying comments published here, are the first part of a symposium held in 1955 at Boston during the annual meetings of the American Anthropological Association. They "are offered as a stock-taking and appraisal of the anthropological research that has been carried on in the Middle American area for the past half century or more." Each paper is followed by comments from two or three participants in the symposium. I find this an excellent editorial approach even though it makes the work more difficult to review because both the papers and the comments are equally worth discussing. Unfortunately, that would take too much space. So I shall undertake here to consider only the papers.

The first, "Middle American Archaeology since 1906" by A. V. Kidder, is excellent but necessarily incomplete, because of the vastness of the subject. Kidder shows very well how out of the prechronological and preproblem stage Spinden, Gamio, Morley, Caso and others started comprehensive surveys and theories that led to real stratigraphy in both the Central Mexican and Mayan areas. Kidder mentions one exception to this: work on the Maya hieroglyphs well under way since Förstemann, in the 1880's. I might add another one: the important 19th century studies on "Aztec" hieroglyphs and calendars. Emphasis is given to the realization of the unity of Mesoamerica, of its possible essential developmental relationships within Nuclear America and an even wider area. A summary of future basic tasks on problems of origin, chronology, and the Olmec and Maya cultures is sketched. I agree with the two commentators, Wauchope and Brainerd, that, through modesty, Kidder did not sufficiently emphasize his own and Carnegie's work in this field.

I wonder why the symposium was called Middle American instead of Mesoamerican. Everyone seems to use Kirchhoff's basic definition and, with some necessary changes in older periods, the boundaries set by him. Kidder, for instance, would have been spared the trouble of going all the way to Panama, thus blurring the area and the co-tradition and confusing the "intelligible unit." Actually the other authors deal only with Mesoamerica.

Gordon Ekholm writes on "Regional Sequences in Mesoamerica and Their Relationships," showing, with the aid of a map and a chart, the archaeological phases in the eight regions into which he subdivides Mesoamerica. A few paragraphs are given to each area showing the different importance each had during its history. This is excellently developed. Interesting comments are made on the amount of intercommunication between the subareas and the conclusion is reached that there must have been much more trade than the archaeology actually shows. General recommendations are made for future research, giving high priority to investigations of the Preclassic and early Classic horizons.

It is unnecessary to mention the numerous (nearly all) points in which I concur with Ekholm. Therefore, I shall only point out some disagreements. In discussing his subareas he makes it clear that the first, "Western Mexico and the Northern Frontier," is a "catch-all category." Still, I believe Guerrero should be excluded on any grounds, except our ignorance of it. Everything indicates a much more complex situation there than in the rest of the area to which Ekholm has linked it. I also disagree (faintly) on the position given to certain phases in the chronological chart. Probably the whole difference stems from the "Olmec question," too long to go into here. I cannot see Monte Alban I about 1300 years before La Venta.

The comfortable tripartite division of Preclassic, Classic and Postclassic seems, more than anything, based on our unconquerable attachment to magic numbers; we need at least six ceramic horizons (Archaic, Formative, Classic I, Classic II, Toltec, and post-Toltec). Besides, a revision of the linking of the Classic beginnings with Stela 9 at Uaxactún seems necessary; if the art of writing is to be the essential distinctive trait, then let us mark these beginnings more clearly by placing the great division at this point and not with an inscription that is rather late in time. I also get the impression that subperiods or phases sometimes acquire an undue importance in Ekholm's chart; for instance, the Pavón to Aguilar sequence in the Huasteca and the Las Charcas to Santa Clara phases in Highland Guatemala.

The third paper, by Tatiana Proskouriakoff, is on Middle American art. Three uses of art are mentioned: the first is the ethnographic, the second tries to catch the symbolism, and the third stresses "the formal properties of design without reference to esthetic values or symbolic meanings." This last method is the one dwelt on especially in the paper. The author is at her usual high level

in showing what has been done and proposing aims of research that might considerably refine and enlarge the usefulness of art study for archaeological purposes. It would be necessary to "build up an organized body of descriptive materials that could be applied to a large range of designs and adapted in different ways to the solution of specific archaeological problems." This possibility is illustrated in the author's mention of the three essential qualities of the Classic styles. The paper is most stimulating, but I would object — as do her commentators — to Proskouriakoff's belief that "critical study of art is not for the archaeologist." The fact that many of us are incapable of art criticism does not mean that we should abandon so wide an avenue to learning. Of course I mean, and so does Proskouriakoff, "scientific" art study — exactly the sort she herself has done.

The last paper, by Eric Thompson, "Research in Maya Hieroglyphic writing," contains a fascinating discussion of the extraordinary work in this field done so far, the possible meaning of glyphs, the chances of our ever reading them, and their usefulness as a clue towards reconstruction of subarea relationships. Thompson believes that the astronomical approach is hopeless. In his discussion E. W. Andrews takes a more optimistic view. Whatever the case, we are anxiously waiting for Thompson's "glyph dictionary," as Satterthwaite aptly calls it.

Every one of the four fine papers here assembled could and should be much expanded. The same is true for the discussions. I wonder at the advisability of requesting such short papers and discussions in cases like this one. Longer papers, even if fewer, and more discussion by able people under an apt and rather autocratic chairman might lead to more fruitful results. The authors have been rather cramped, which shows the necessity of more space. Still, in its few pages this volume is a most important contribution on a high level. There are a few bibliographical and printing errors, such as Kelley instead of Kelly.

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The Aztecs, People of the Sun. Alfonso Caso. University of Oklahoma Press, Norman, 1958. xvii + 125 pp., 42 color illus., 16 photographs. $7.95.

This work is the second English translation of the booklet issued in 1936 as part of the *Enciclopedia illustrada Mexicana* under the title *La Religión de los Aztecas*. It was first issued in English in 1937 in the *Popular Library of Mexican Culture*, published by the American Book Store in Mexico City. Caso emended and enlarged the text for the present translation, which is illustrated with 42 offset reproductions of ink line drawings by the late Miguel Covarrubias, reproduced in six flat colors.

The text was originally intended to enlighten the beginner about the intricacies of the Aztec pantheon. The present enlarged version faithfully adheres to the same purpose. An introductory section on the categories of early religious development distinguishes magic from religion. Religious sentiments take polytheistic, dualistic, and monotheistic forms in the persons of the gods. In Aztec life, polytheism dominated popular belief; monotheism and dualism were subjects of speculation by priestly persons. Following this introduction, many short chapters, often only a few paragraphs long, discuss Aztec ideas of genesis, cosmography, pantheon, and eschatology. A few pages discuss calendar and priestly organization, and the book concludes with a section on the Aztec conception of the central importance of sacrifice as a guarantee of the stability of the universe. There are 16 good reproductions of photographs of statues and objects related to the cult of the gods. An index is provided, but no bibliography, and other interpretations, such as Jacques Soustelle's *La Pensée cosmologique des anciens mexicains* (Paris, 1940) are nowhere mentioned. The sources of Caso's knowledge are also not mentioned. Any future history of speculation about Aztec thought will nevertheless give an important place to this readable, if elementary, work which has been more influential than any other in shaping our popular conceptions.

George Kubler
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The Aztec: Man and Tribe. Victor W. von Hagen. Mentor: Ancient Civilizations, New American Library, New York, 1958. 222 pp., 55 figs., 21 pls. $0.50.

Judging from the steady flow, descriptions of ancient cultures and general treatments of archaeological topics perennially interest the reading public. The pocketbook and paperback publishers, responsive to this market, are expanding their coverage of this field, occasionally with excellent offerings. The volume under consideration is one of the latest fruits of this trend; it is the second of a planned trilogy by the same author covering the leading high cultures of the Americas (*Realm of the Incas*, appeared in 1957; a Maya volume is forthcoming).

Appraising, in a professional journal, an avowedly popular book designed to reach a large layman audience is always difficult. Obviously the canons of criticism which apply in the case of a work prepared by a specialist cannot be employed in these cases. Certain features, however, can be fairly expected in a successful popular book, such as readability without excessive romanticism or overdramatization, good organization, up-to-dateness, and basic factual accuracy. The present volume must be scored rather lightly in these categories, particularly in the last. Merely to catalog the numerous errors of fact and interpretation would consume many pages. We are told, for example: that man first entered the New World in "the early neolithic stage of development"; that the Aztecs entered the Valley of Mexico in 1168 (actually one date for their legendary departure from Aztlan); that Nahua-speaking Cholula, whose Great Pyramid was torn down to provide material for Spanish colonial buildings, was the Mix-

tec capital and is the present day Puebla; that Aztec leaders were entombed rather than being cremated; that the Conquest period Tarascan capital, Tzintzuntzan, dates from A.D. 500–800; that Monte Alban IV is Mixtec and that this ceremonial center was in continuous use until the time of the Conquest; that Aztec religion lacked "a goddess of love" (in the face of the existence of Xochiquetzal and Tlazolteotl); that the Great Wall of Huexotla (south of Texcoco in the eastern Valley of Mexico) is a remnant of the wall which defended Tlaxcala; that a mosaic-encrusted Teotihuacan-style stone mask (Pl. 5), found by Aguirre in Malinaltepec, Guerrero, in 1921, came from "the tombs of Monte Alban, the sacred temple of the Mixtec"; that Xipe was a goddess; that the xiuhmolpilli (52 year cycle) was the 365 day year; that a "glyph history" of the La Venta–Olmec exists.

This list of minor errors could be greatly amplified, but it is probably more profitable within the compass of this brief review to concentrate on mistakes of greater moment. One of the most striking is von Hagen's continuance of the discredited Toltec-Teotihuacan equation (his Toltec tent is large enough, however, to include the actual Toltecs of Tula). Equally serious is his maintenance of the even more thoroughly discredited ideas of Bandelier (unfortunately perpetuated by Vaillant) on the nature of Aztec socio-political structure, including nearly all of Bandelier's major errors, such as democratic orientation, rank without class, the calpulli an exogamous clan, only 20 calpulli in Tenochtitlan. None of the recent research (Manuel Moreno, Caso, Kirchhoff, Monzon, Acosta Saignes, Freund, Katz, and others) on this important theme is cited, which, without by any means solving all the many problems still current in this area, has at least exposed the essential fallacy of the Morgan-dominated Bandelier scheme. The general scope of coverage is more or less adequate, but Aztec political history is markedly slighted, and, for a writer who accurately recognizes the tremendous importance of religion in Aztec culture, von Hagen devotes relatively scant space to it, particularly to the gods and their functions. The treatment of the calendar is confused and garbled, with no notice taken of the recent and significant revisions of earlier views.

On the side of organization, a certain general looseness is apparent. Often major topics, such as taxation, the tribute system, and marketing, which logically belong together, are separated by intervening chapters. The integration of the notes with the bibliography was probably an unfortunate choice of format in a book designed for the general public, which would unquestionably profit by a separate list of fundamental works in English on the topic. The incompleteness of the bibliography is also noteworthy; many of the major, virtually indispensable, works on Aztec culture are missing.

As to style, the heavy sprinkling of non-Mexican literary and historical allusions often seems excessive, although generally the reader is carried along at a fairly sprightly, if somewhat uneven, clip. The number of spelling errors, mostly of Nahuatl words, is prodigious; not all of these can be purely typographical. In general, one gains the strong impression that the book, derived largely from secondary sources and mere spot-dipping in the primary documentation, was rather hastily prepared.

Finally, to end on a note of high praise, the line drawings by Alberto Beltrán are excellent and very successfully capture both the essential spirit of Aztec draftsmanship and of the colorful culture they illustrate. The book can be strongly recommended on the basis of them alone.

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Surface Survey of the Northern Valley of Mexico: The Classic and Post-Classic Periods. PAUL TOLSTOY. Transactions of the American Philosophical Society, n.s., Vol. 48, Part 5, Philadelphia, 1958. 101 pp., 10 figs., 14 graphs. $2.00.

Here is a publication of first rate interest for Mexicanists and of greater importance than the title would indicate. Tolstoy brings together a vast amount of surface material from 111 sites of the Classic and Postclassic horizons. Through the seriation technique developed by Ford he has reclassified the major ceramic types and arranged the samples in series representing their succession in time. The major drawback of this technique, which indicates sequence but not time, is of relatively little importance in this case, where the general framework of sequences in the Valley of Mexico has been well established since excavations revealed Tula, Hidalgo, as the historical Tula of the Toltecs.

Tolstoy devotes considerable space to the aims and procedures of his project. His purpose is to "present a descriptive outline of the sequence of ceramic types which subsequent investigators may expect to find in the areas and periods" which he studied. At the same time the reader is given another demonstration of the seriation technique in extracting chronology from surface collections. Considerable space is devoted to the defense of this technique. Mixture, due to redeposition, was minimized by choosing the terrain carefully, spot collecting (limiting the area as much as possible from under a square foot to several square yards), and in several instances repeating the samples several times. Problems arising regarding chronology in seriation are (1) irregularities in culture change, (2) spatial variation, (3) social and functional variation, (4) mixture, and (5) chance. It is concluded that most conceivable irregularities in culture change will not drastically affect the seriation. In some cases it was desirable to show regional differences, so Teotihuacán, San Miguel Amantla, and Tula were sampled individually. For the Postclassic collections from the northern Valley, a few sites were sampled within a radius of a few miles and then increasingly distant locations were included. In this way, five Postclassic areas in the northern Valley were set up: Tenayuca, Tepeyac, Ecatepec, Xaltocan, and Texcoco. These areas are clearly marked and sites numbered on a splendid map at the beginning of the paper.

The procedure used for setting up types was (a) preliminary tabulation of promising features, and (b) subsequent changes and trials of new criteria made as the necessity arose. The result was an increase in the sensitivity of typology to time and change and the more efficient use of available data. In this report an attempt was made to use all ceramic material rather than to select out decorated sherds or distinctive fragments. Type criteria were finish, slip color, and decoration with form and paste also taken into account when deemed important.

The bulk of the report is given over to a minute description of ten major ceramic types for the Classic Horizon and nine for the Postclassic. This is followed by a breakdown of each horizon into subdivisions which Tolstoy calls "periodizations." The Classic is composed of Teotihuacán I (600–200 B.C.), II (200 B.C.–A.D. 250, corresponding to El Corral I), III (A.D. 250–650), IV (A.D. 650–900, corresponding to El Corral II). Postclassic is set up as follows: Tula (900–1200), Early Aztec (1200–1400, Vaillant's Aztec II), Late Aztec (1400–1500, Vaillant's Aztec III). In addition Tolstoy refers to Time A, B and C (C representing the end of Tula, CB Early Aztec, BA Late Aztec, and A the conquest), which seems to me to be a pointless complication. A brief review of the Archaic sequence follows in which he agrees that there are indications of relationships between Ticoman and Teotihuacan I. In fact, the author agrees with the bulk of Vaillant's conclusions.

Classic culture at Teotihuacan in Period III is of special interest because of the absence of certain traits which are shared by earlier and later periods in the Valley. These include tripod bowls, ladles, molcajetes, white-slipped ware, painted red ware, and low annular bases in monochrome ware. Tolstoy suggests the Tlaxcala-Puebla area as a possible source of the true classic group of traits. The differences seen at Amantla might be due to bearers of a highland Classic culture coming in a bit later from the southern Valley. More precise conclusions are hampered by lack of Classic sequences east and west of the Valley as well as the lack of a figurine study. The transition between Late Classic and Tula is still obscure and this report does not contribute to clarification of this turning point. Tolstoy does believe, however, that this discontinuity is less marked in the western part of the survey area than in the eastern.

For the Postclassic horizon there is some evidence of overlapping complexes in the decorated Tula and brush-slipped series and some decorated Aztec types. The Texcoco area may prove to be the first Early Aztec center of orange and red ware types if abundance is meaningful. Trade sherds and other types point to eastern contacts, the southern Valley, and Puebla. On the basis of this survey, the Tepeyac seems the most backward area of those studied. The report ends with a concise summary of culture history in the Valley of Mexico as we know it today.

Tolstoy has made an important contribution in three respects. First, he has arrived at many of the same conclusions as Vaillant, Armillas, Caso and others by using an entirely new technique for the Valley of Mexico. This will be very reassuring to many. Second, I feel his survey points up many useful hints for future work in the Valley and certainly brings out the usefulness of seriation in this area. Third, he has done us a service by bringing together a vast amount of material, including much information in Vaillant's unpublished notes. Especially useful is a section under the description of each type called Synonyms and References. I found the report tough reading due to Tolstoy's particular style of writing. This is definitely a paper for specialists. As such, it will be an invaluable reference work, and one which would merit a Spanish translation.

Muriel Noé Porter
Havana, Cuba

NOTES AND NEWS

EDITED BY NATHALIE F. S. WOODBURY

SOVIET EXCHANGE

Some anthropologists from the United States, notably Froelich Rainey, Chester Chard, Lawrence Krader, and Gordon Hewes, have visited the Soviet Union during recent years, and one Russian anthropologist, George Debets, spent several months in this country during 1957. However, the first full exchange of anthropologists, under the terms of the cultural exchange agreement signed by representatives of the United States and the U. S. S. R. in January, 1958, was begun in September of that year. During a two month period Irina Zolotarevskaya, an ethnologist from the Ethnographic Institute in Moscow, who is concerned with problems relating to the Indians of the southeastern United States, visited this country, and H. M. Wormington, Curator of Archaeology at the Denver Museum of Natural History, was received in the Soviet Union. A grant-in-aid awarded to Wormington by the Wenner-Gren Foundation for Anthropological Research provided for her travel expenses to and from Moscow and supplied funds for the expenses of Zolotarevskaya during her stay in the United States. The Academy of Sciences of the U. S. S. R. took care of Wormington's expenses while she was in the Soviet Union.

Zolotarevskaya visited the American Museum of Natural History and the Museum of the American Indian in New York, the University of Pennsylvania Museum in Philadelphia, and the Library of Congress in Washington. From the east she went to the University of Oklahoma in Norman where she worked in the Stovall Museum and later visited some Indian groups under the guidance of Alice Marriott. Next she went to Denver where her time was divided between the Denver Art Museum and the Denver Museum of Natural History. Before going back to Moscow she returned to Washington for the annual meeting of the American Anthropological Association.

During this period Wormington was the guest of the Academy of Sciences of the U. S. S. R. and worked with Paleolithic and Mesolithic collections from eastern Siberia in various institutions in the Soviet Union. She received the most splendid cooperation from Soviet anthropologists, collections were made freely available for study and photographing, and every aid that could conceivably facilitate her studies was provided.

During the first week in Moscow Wormington visited the Ethnographic Institute, the Institute for the History of Material Culture, and worked with collections in Moscow University and the Historical Museum. After having completed this part of the work she went by jet to Irkutsk near Lake Baikal in southeastern Siberia and spent a week studying collections in the Museum there. The remainder of the time, except for two brief periods in Moscow, was spent in Leningrad where the main Siberian collections are kept. Here Wormington studied and photographed collections in the Institute of Ethnography's Museum of Anthropology and Ethnography, the Institute for the History of Material Culture, and the Hermitage. The results of these studies will be reported at a later date in the Proceedings Series of the Denver Museum of Natural History.

RADIOCARBON DATES ON CARDS

The ad hoc committee established to study the feasibility of distributing edge-punched cards bearing radiocarbon dates was replaced, during the spring of 1958, by Radiocarbon Dates Association, Inc. Frederick Johnson is president, Douglas S. Byers is treasurer, and with Richard Foster Flint, they comprise the board of directors.

The "market survey" which mailed about 15,000 pieces of promotional data all over the world revealed a large demand for the cards. Unfortunately, the cost of production, $250 for a set of 5000 cards, was such that a bare minimum of subscriptions have been received. It is interesting to note that relatively the number of subscriptions from Europe and the Far East exceeds the number from the United States. Thanks to the generosity of John Ramsden and Robert Pollard, who represent the suppliers and printers, it has been possible to establish a limited program. The delivery of sets of about 1000 cards each, plus the necessary sorting needles, punches, and so forth, will have been made by the time notice appears. It is too early yet to set up a definite production schedule, but there is a possibility that about 4000 cards, amounting to the estimated total number of dates to be published by July 1, 1959, will be delivered during the fall and winter of 1960. The remaining 1000 cards which the Association has contracted to send subscribers will be distributed as soon as they are published, which, at the present rate, could be during the winter of 1960–61.

It would have been impossible to organize this project without the assistance of the Wenner-Gren Foundation for Anthropological Research and the National Science Foundation. The Association is indebted to both these organizations for their confidence and generosity. The project is operating on a meager budget, one in which the possibility of normal commercial profit to the companies concerned hangs in the balance. Even the possibility that Radiocarbon Dates Association may remain solvent is uncertain. Under such circumstances it is not possible to guarantee that there will be sets of cards available for general sale to nonsubscribers. Those who contemplate purchasing a set of cards in the future should communicate immediately with Frederick Johnson, R. S. Peabody Foundation for Archaeology, Box 71, Andover, Massachusetts.

ARCTIC

WEST GREENLAND. During the summer of 1958 Helge Larsen, accompanied by Mrs. Larsen, made a four-week reconnaissance of Paleo-Eskimo sites in the inner parts

of Godthaabs and Ameralik fjords. Ten sites were investigated, all of them representing the Sarqaq culture. The most significant finds were made at Itivnera, Godthaabs Fjord, where an occupation area of at least 200 sq. m. was discovered well above the high-water mark. Probably as many as ten dwellings are hidden there by a willow thicket and a 60-cm. layer of sphagnum and peat. Assisted by Jens Rosing of the local Reindeer Experimental Station the Larsens excavated one of these dwellings and obtained over 300 specimens. The inventory of types was similar to that of the Disko Bugt Sarqaq, although in this case quartzite, not angmaq, was the predominant material used for the manufacture of stone artifacts. In addition, this site produced artifacts of antler and bone, the first specimens made of organic materials to be found in the West Greenland Sarqaq culture. Considerable food-bone debris was present, most of it caribou, but including some seal and bird bones. Specimens of wood and charcoal were also taken, and a human molar, the first known physical trace of Sarqaq man, was found. A geological party, consisting of A. Rosenkrantz and K. Skov, discovered another Paleo-Eskimo site at Ikorfat on Nugssuaq Peninsula, Umanaq district. Here were found two well-defined occupation levels, Dorset above and Sarqaq beneath, separated by a layer of beach pebbles. Both strata contained organic materials, but the most important finds were two Dorset harpoon heads of early types which support the assumption that West Greenland Dorset culture was earlier than classical Dorset.

Assembled by Elmer Harp, Jr.

NORTHWEST

Idaho. Earl H. Swanson, Director of the Idaho State College Museum, is making arrangements for three field projects: (1) a three-year study of archaeological sites in east-central Idaho; (2) a joint ISC Museum–Peabody Museum expedition in south-central Idaho; and (3) an intensive survey of the Owyhee desert in southwestern Idaho.

Washington. Two archaeological salvage projects will be carried out during the summer by crews from the State College of Washington. The annual archaeological field school, with 20 students enrolled, will be working in the Ice Harbor Reservoir on the lower Snake River. Excavations will be at several sites, including an extensive village site and a burial island. Richard D. Daugherty will supervise the project under a contract with the National Park Service. The second project involves salvage excavations in the Rocky Reach Reservoir in the middle-Columbia area. A crew of eight, led by Roderick Sprague, graduate student in anthropology, will sample a number of sites within the reservoir. An archaeological survey of this stretch of the Columbia River disclosed that this area is not as rich, archaeologically, as most other portions of the river.

British Columbia. Under the direction of C. E. Borden, the University of British Columbia will begin systematic excavations at Site DjRi:3 in the Fraser Canyon. Preliminary investigations at this deep site have revealed a series of intermittent occupations separated by sterile sands and gravels. In conjunction with this project, site surveys will be conducted along the lower course of the Fraser in an effort to locate sites which may yield information on the gap of some 5000 years that exists at present between the earliest occupation at site DjRi:3 (8130±310 B.P.) and Marpole (2900±170 B.P.), the earliest known settlement at the mouth of the river.

Assembled by Charles E. Borden

GREAT BASIN

During the summer of 1958 the University of California (Berkeley) completed archaeological salvage excavations on Alder and Prosser creeks a few miles north of Truckee. The artifact assemblage is assignable to the Martis complex. A site on the East Fork of the Carson River, also excavated by a University of California field party, yielded protohistoric Washo materials. The results of these investigations are described in a report entitled "The Archaeology of Three Central Sierran Sites," prepared by James T. Davis for the National Park Service which sponsored the work.

Also working under a National Park Service contract, field parties from the University of Southern California continued investigations in Death Valley National Monument and Joshua Tree National Monument. During the Christmas holidays two campsites at Saratoga Springs in Death Valley were partially excavated. The first produced artifacts of the Death Valley III (Roger's original Amargosa II) complex, dating roughly between A.D. 900 and 1100. Of particular interest was the exposure of a series of darkened soil layers, tentatively identified as bands of humus. This would indicate a much moister climate and a more luxuriant plant growth than exists in the vicinity today. The second campsite also produced Death Valley III artifacts but these were mixed (to a depth of 24 to 30 inches) with small, side-notched "Shoshonean" points and a few plain sherds, also presumably of Shoshonean origin. This suggests an overlapping in time of the two complexes and intermittent occupation of the site by peoples with two distinct cultural traditions. In January, a U. S. C. field party surveyed the Deep Tank–Squaw Tank area of Joshua Tree National Monument recording 23 sites with pottery or other artifacts attributable to the late prehistoric period.

Although only indirectly connected with problems of human occupation of the Great Basin, the dating of sloth dung from the Rampart Cave in Lake Mead National Recreation Area will be of interest to many archaeologists. The cave is located 4000 feet below the rim of the Grand Canyon, a few miles above Pierce Ferry. Samples of the droppings of the now extinct animal were collected by Dick Shutler and analyzed at the University of Arizona Geochronology Laboratories. It has been reported that the sloth lived in Rampart Cave between 10,000 and 35,000 years ago. Analysis of grains of pollen, which passed through the sloth's digestive system relatively unchanged,

indicates that local conditions were much the same as today 35,000 years ago, as well as 10,000 years ago when the animal disappeared. It was dry and hot, and the pollen is predominantly from relatives of sunflowers and asters such as might be found in the area today. About 12,000 years ago, however, the sloth ate pine, juniper, and sagebrush, plants which have since retreated to higher elevations. This demonstrates a cooler, moister climate at this time. No evidences of man's presence have been found in Rampart Cave.

The Sixth Great Basin Archaeological Conference will be held September 10 and 11 at the Santa Barbara Museum of Natural History. Titles and abstracts of papers and comments on programming should be sent to Ruth D. Simpson, Southwest Museum, Highland Park, Los Angeles 24, California.

Assembled by WILLIAM J. WALLACE

SOUTHWEST

PECOS CONFERENCE. The 1959 Pecos Conference will be held at Cantonment Burgwin near Taos, New Mexico, August 28, 29, and 30. Cantonment Burgwin and its sponsor, the Wichita Foundation, will be hosts. Fred Wendorf is chairman of the interim committee.

WETHERILL MESA PROJECT. At Mesa Verde National Park, Colorado, the Wetherill Mesa project, a five-year research program sponsored jointly by the National Park Service and the National Geographic Society was launched last summer with Douglas Osborne directing the project. An archaeological site survey of the mesa has been made by Alden C. Hayes who recorded a large number of surface sites and cliff dwellings. Three large cliff dwellings, Long House, Mug House, and Step House, are to be excavated, along with several surface sites on Wetherill Mesa representing various time periods. Full scale excavation has been started at Long House by George S. Cattanach.

UPPER COLORADO RIVER STORAGE BASIN. In the Glen Canyon Dam section the University of Utah is conducting excavations in the area of the upper Glen Canyon between the San Juan and Dirty Devil rivers. In the area of the lower Glen Canyon sites being excavated by the Museum of Northern Arizona, under the direction of William Y. Adams and with the assistance of Alexander J. Lindsay, Jr., and Christy G. Turner II, are those to be flooded by water backed up by the recently completed coffer dam. In the Navajo Dam section the Museum of New Mexico is concluding reconnaissance and has begun excavation in Navajo sites of the area under the direction of A. E. Dittert, Jr., with the assistance of Frank W. Eddy and Jim J. Hester.

ARIZONA. The Museum of Northern Arizona conducted two small scale excavations in the Verde Valley late in 1958. At NA 3528, six miles south of Camp Verde, a large Hohokam trash mound was trenched. It produced large quantities of ceramic material dating from the time of Kana-a Black-on-white and Gila Butte Red-on-buff through the period of Black Mesa Black-on-white and Sacaton Red-on-buff. One Sacaton phase dwelling was excavated. At NA 4616, in the flat just west of Montezuma Well, two Sacaton phase units were excavated in cooperation with the National Park Service. One was small and obviously a dwelling. The other was a communal structure that measured 31 by 19 feet and had a stepped bulbous entry to the east. A screen or deflector was indicated in the center of the house, opposite the entrance but on the far side of the fire pit.

The Orme Ranch cave in the upper Agua Fria drainage was excavated by student labor from the Orme Ranch School under the direction of David A. Breternitz of the Museum of Northern Arizona. The upper levels produced Yavapai pottery and perishable material, while the lower levels contained prehistoric Pueblo pottery which ties in with house sites presently being excavated by Robert Schley, science instructor at the Orme Ranch School.

Michael J. Harner, Department of Sociology and Anthropology, Arizona State University at Tempe, has initiated weekend excavations in a dry rockshelter on a mountain slope overlooking Phoenix. The deposit in the shelter shows considerable disturbance by amateur collectors who are reported to have removed ceremonial bundles, cotton textiles, and prayer sticks from the site. Preliminary test excavations have resulted in the discovery of corn cobs, cane cigarettes, and an extensive natural deposit of salt in the bedrock of the shelter.

Paul S. Martin and John B. Rinaldo of the Chicago Natural History Museum have been analyzing material from the site excavated last summer near St. Johns in northeastern Arizona. In an effort to work out a sensible classification of the plain brown wares and to gain some perspective on the painted and textured wares, they have employed several techniques: refiring sherds, disaggregation, X-ray diffraction, X-ray fluorescence, polished sections, and petrography.

The Arizona State Museum, under contract with the National Park Service, has finished its first season of field work on the Painted Rocks Reservoir project of salvage archaeology near Gila Bend in southwestern Arizona. William W. Wasley supervised with the assistance of Frank W. Eddy. From November 15 to February 28 the work was confined to excavation in and near a large mound of the Sacaton phase of the Hohokam culture at the Gatlin site (Arizona Z:2:1). This mound consisted of a complicated series of slope-sided, round-cornered, flat-topped platform mounds made of earth and faced with adobe plaster. Six major stages of construction have been defined. Five individual mound units were extant during each of two early periods of use. Each of the major construction stages showed evidence of one to four periods of repair or modification. During two of the major periods of construction and use the functioning platform mound complex consisted of a nucleus of two major mounds with three small outlying mounds connected to the nucleus by radial wing walls.

Evidence of a structure on top of the platform mounds was limited to a single posthole pattern of what appeared to have been a rectangular jacal unit. There was also a fire basin on top of this same mound, outside the structure. On top of one of the other platform mounds was another fire basin. Although ramps or stairs must have been used to gain access to the tops of the six major platform mounds, the partial destruction of earlier phases of the construction by later additions and the very impermanent nature of all of the construction made it impossible to find conclusive evidence of ramps or stairs of any type. The maximum size at the base of the largest platform mound, the final one which was roughly rectangular in outline, was about 27 by 22 m. This mound was 3 to 4 m. in height, although the entire top had been eroded away. The smallest major platform mound was only about 1 m. high and was roughly 10 m. long and 5 m. wide at the base.

On the basis of the ceramic evidence it can safely be said that the entire mound complex was built, used, and abandoned during the Sacaton phase which in this area appears to have lasted from about A.D. 950 to 1150. However, also on the basis of ceramics, but lacking a complete ceramic analysis, it seems very likely that the entire history of this mound was compressed into the latter part of the Sacaton phase. The significance of this platform mound complex, thus far unique in the history of Hohokam archaeology in general and of the Sacaton phase in particular, is that it reflects a northern extension into the Hohokam area of the Mexican pyramid idea. Specific links with a particular locus or culture in Mexico, as might be expressed by trade objects, have not been found at the Gatlin site as yet. Field work at this ruin and at other sites in the area will be continued in the fall.

Chihuahua. The Joint Casas Grandes Expedition of the Instituto Nacional de Antropología e Historia and the Amerind Foundation has uncovered a large ballcourt associated with a trash-filled truncated pyramid and several mound units, one having an enclosed cluster of rooms which was probably used as a temple structure. The ceremonial buildings are located along the western periphery of the Casas Grandes ruin and are separated from the great houses by a well defined central plaza. There is an unusual balance in the settlement pattern between ceremonial structures and habitation sites. To date the ceramic complex indicates a single phase of occupation. Based on such trade pieces as St. Johns polychrome, Chupadero Black-on-white, and El Paso, Gila, Tonto, and Tucson polychromes, a possible time span from the mid-13th century on is suggested.

The staff consists of Charles C. Di Peso of the Amerind Foundation, director; Eduardo Contreras of the Instituto Nacional de Antropología e Historia, subdirector; Boyd N. Wettlaufer, archaeologist; Robert C. Trujillo, archaeologist; Alfred A. Cohn, photographer; Margaret H. Cohn, photographer and secretary; Frances Di Peso, bookkeeper; and Hattula Moholy-Nagy, cataloguer and secretary.

Colorado. Herbert W. Dick, director of the Trinidad State Junior College Museum, has inaugurated a dendrochronology program at the Museum and is preparing a master chronology for the region. A pottery analysis laboratory has been established with the necessary equipment to prepare and study pottery thin sections. The first project is now under way for the Peabody Museum West of the Pecos. Inquiries are invited from those who desire small lot studies. It is anticipated that the operation will be expanded as soon as more laboratory space is acquired. X-ray techniques will be an important part of the research. Excavations in Spanish missions were conducted by Dick last fall at Abiquiu and Santa Rosa de Lima Mission on the Chama River in northern New Mexico. Under a grant from the Society of the Sigma Xi the Museum has been studying deep alluvial deposits in the Chicosa Valley ten miles north of Trinidad, Colorado.

New Mexico. Salvage excavation by the National Park Service of a small pueblo at Chaco Canyon National Monument was accomplished last fall under Zorro A. Bradley. Ten rooms and a kiva were uncovered during the excavation. The site was occupied from about A.D. 1050 to 1100. It was abandoned and later re-occupied by Mesa Verde people in the late 1200's. Underlying the pueblo and exposed on the bank of the Chaco Wash was approximately half of a Pueblo I pit house which was also excavated.

The second season of the Museum of New Mexico's excavations in the Taos area was completed last summer under the direction of Fred Wendorf who continued work on the Pot Creek ruin, one of the largest Pueblo III villages in the northern Rio Grande drainage. A block of ten rooms was dug at this site. In the floor of each of these rooms was a large central basin in the center of which was a vertical post. The purpose of these posts and basins could not be determined. In addition to digging in the large pueblo, three Pueblo II pit houses were cleared. Each of these houses was circular, from 10 to 18 feet in diameter and from 6 to 8 feet deep. Their features, including eastern ventilator, roof post arrangement, fire and ash pits, are similar in general pattern to those of subterranean structures attributed to the Rio Grande Anasazi. Excavation and restoration activities at the pre-Civil War fort, Cantonment Burgwin, continued with the clearing of the commandant's house and the post hospital.

The Museum of New Mexico's highway salvage excavations, under the direction of Stewart Peckham, have resulted in the clearing of eight sites since the summer of 1958. In July three sites were excavated in the San Jose Valley east of Laguna Pueblo including two Pueblo I-II pit house sites and a seven-room jacal pueblo with two kivas. In January, a single pit house was excavated in the same area and marked the last highway salvage excavation to be done along a 45-mile traverse from Albuquerque to Laguna Pueblo which netted eight sites ranging from Basket Maker III to Early Pueblo III.

The largest single excavation of the 1958 season took place in August with the digging of a Mimbres pithouse village located on a terrace overlooking Duck Creek, about

20 miles south of Haury's Mogollon Village. Seven of the eight rooms dug were pithouses including one of Georgetown, two of Three Circle, and four of Classic Mimbres phases. One of the latter pithouses was of particular interest in having masonry walls and possessing floor features identical to the so-called "pithouse-kivas" of the Reserve and Apache Creek phases in the Reserve area to the north. The remaining structure on the site was a single, masonry-walled surface room.

Two sites were excavated in November. One site consisted of a single pithouse located southwest of Ranchos de Taos, New Mexico. In all its features the room was identical to those in the Pot Creek area excavated by Wendorf. The second site, the smallest ever encountered on a highway salvage project in New Mexico, consisted of a single Navajo sweat lodge near Datil. Though small and of modern vintage, the site did provide additional information concerning the construction and distribution of this distinctive Navajo architectural form.

Through the courtesy and interest of the Los Alamos Scientific Laboratory and Frederick C. V. Worman of the Laboratory, a Geiger-Müller tube and scaling unit has been installed at the Museum of New Mexico under a long-term loan. It is hoped that the device will prove useful for relative dating purposes such as those recently discussed by Kenneth P. Oakley and Arthur E. Rixon (1958, *American Antiquity*, Vol. 24, No. 2, pp. 185–7). In addition to measuring radiation from bone samples from paleo-Indian sites, some success has come from radiation measurement of soil samples and potsherds.

Most recently initiated at the Museum of New Mexico is a long-term project of archaeological survey and excavation concentrating on sites within a 40-mile radius of Tucumcari, New Mexico. The eastern plains of New Mexico have received scant attention in past years in spite of the wealth of archaeological and historical material known to occur in the area. Assisting the Museum on this project is the Tucumcari Historical Research Institute, a local organization concerned with the preservation of archaeological and historical sites and objects in the area. Preliminary surveys carried out by Stewart Peckham in December recorded sites representing almost the full chronological range known for the New Mexico plains.

Assembled by WILLIAM W. WASLEY

PLAINS

It is planned to report hereafter the major news of developments in the Plains area in the January and March issues, when summer field work and the Plains Conference can be reported. In the July and September issues only special items of immediate interest will be reported.

SOUTH DAKOTA. George Agogino of the W. H. Over Museum, State University of South Dakota, reports that in December, 1958, an agreement setting up a state archaeological highway salvage program was signed by the State Highway Commission, the W. H. Over Museum, the South Dakota State Archaeological Commission, and the Department of History at the State University of South Dakota.

IOWA. *Bison occidentalis* associated with large side-notched points, extinct snails of genus *Helisoma*, and with a radiocarbon date of 8430±540 B.P., have been found at the Quimby Bison Quarry, a buried kill site on the Little Sioux River two miles west of Quimby in northwestern Iowa. The points are essentially the same as the one found in 1955 at the Turin burial site 40 miles southwest of Quimby. The bison, of which more than 100 individuals are probably represented, have been identified from horn cores. The radiocarbon date was obtained from charcoal from fire pits, and was determined by Isotopes, Inc. The field work was done by W. D. Frankforter of the Sanford Museum in Cherokee, Iowa, and members of the Northwest Chapter of the Iowa Archaeological Society, in collaboration with George Agogino of the W. H. Over Museum, State University of South Dakota. The Quimby and Turin sites, and the lower levels at Modoc Rock Shelter in southwestern Illinois, are beginning to reveal a hitherto unsuspected cultural complex in the western prairie country, in the pre-Altithermal time when the makers of Scottsbluff and Angostura points were hunting bison farther west on the High Plains.

Assembled by E. MOTT DAVIS

NORTHEAST

The excavation of sites which are historically documented continues to provide a series of artifacts which will assist in dating sites of undocumented occupations. During the excavation of a cemetery associated with a refugee Wyandot village of 1748, near New Castle, Pennsylvania, a variety of glass beads, brass kettles, gun flints, silver brooches, shoe buckles, knives, thimbles, and iron axes were recovered. The excavator, Marco M. Hervatin of West Pittsburgh, Pennsylvania, recovered a rare King George II medal. It must have been minted during 1737 or 1738, when Queen Caroline served as regent of the British Government. It is the only British medal minted between the reigns of Elizabeth and Victoria which bears a queen's portrait. Two other examples of this medal were recovered by John Witthoft of the Pennsylvania State Museum, in the Vernon Hixon site at Locust Grove, Bainbridge, Lancaster County, Pennsylvania, which was the Conoy town of 1718–1748.

The results of the archaeological surveys conducted under the auspices of the National Park Service during 1958 have been supplied by John L. Cotter, Regional Archeologist. The final report on surveys of seven reservoir areas in New England submitted by Douglas F. Jordan indicated no need for salvage operations. The general conclusion of the surveys was that the narrow valleys of New England streams offered little or no inducement to the Indians wishing to establish occupational sites. Jacob W. Gruber, Temple University, reported on three reservoir areas on the Delaware drainage of Eastern Pennsylvania: Dyberry, Prompton, and Bear creeks. The results of his observations and tests indicate that there was heavy occupation along the banks of the Delaware and its upper reaches from the Middle Woodland period on. But in the

backwater reaches of the winding Paupek and Lackawaxen rivers the remains of glacial activity probably rendered the terrain untenable and ecologically inaccessible. Also inhospitable were the upper reaches of the Lehigh Valley where Bear Creek Reservoir is located, although a few Middle Woodland sites were found. A partial survey of the Kinzua Reservoir area (New York–Pennsylvania) was made by William A. Ritchie, New York State Museum and Science Service, who located and recorded some sites, but judged none worthy of salvage excavation.

Maryland. A sample of charcoal from a fire pit obtained by the Southwestern Chapter of the Archeological Society of Maryland during the course of test excavation of a nine-acre site at the junction of Seneca Creek and the Potomac River about 16 miles northwest of Washington, D. C., has been dated by the Radiocarbon Laboratory of the U. S. Geological Survey at 1960 B.P. ± 160 years ago (1 B.C.; W–798). The site has yielded mainly heavy quartzite artifacts of Archaic type, but there is a mixture of smaller white quartz and rhyolite artifacts. The fire pit and a few sherds of quartz-tempered pottery were found in the part of the site where the white quartz tools are most common; a fragment of a steatite vessel was found where the quartzite artifacts predominate.

Assembled by Alfred K. Guthe

SOUTHEAST

Representatives of the National Park Service, the Smithsonian Institution, and Georgia, Alabama, and Florida institutions held a preliminary planning conference at Columbus, Georgia, in January to set up salvage operations in the Walter F. George and Columbia reservoirs on the lower Chattahoochee River. By mid-February work was begun by three Smithsonian crews in the Walter F. George Reservoir; an early move to the Columbia Reservoir is planned. A major project will be the excavation of the mixed Creek and Georgian town of Roanoke which had an extremely short span of occupation and should give good temporal control for artifact styles. Lewis H. Larson, Jr., Georgia Historical Commission, has begun a short-term program of excavation in these basins in the hope of obtaining datable trade items.

Robert S. Neitzel supervised a National Park Service –University of Georgia excavation at the Cherokee town of Chauga in Oconee County, South Carolina. The ten mound stages run from Etowah-like material to a Savannah-like complex. Edward V. McMichael and James H. Kellar have been digging in the Georgia Power Company Oliver Dam area on the Chattahootchee River. Other salvage archaeology in the Southeast includes work sponsored by the National Park Service in Arkansas and Kentucky. The University of Arkansas found 80 sites in the Greer's Ferry Reservoir. The University of Kentucky has finished work on a rockshelter in the Rough River Reservoir and plans additional work in the Barkeley Reservoir on the Cumberland.

Hale G. Smith and Charles H. Fairbanks, Florida State University, excavated tests at a Fort Walton ceremonial site on Choctawhatchee Bay. They encountered no burials, but found extensive "pavements" of broken pottery vessels, the purpose of which is not clear. The material reveals new combinations of Fort Walton pottery types as well as new decorative techniques, including a watery black paint and incised lines filled with either red or white pigment. John M. Goggin, University of Florida, has begun the combined land and underwater investigation of a series of Deptford and Swift Creek sites in Taylor County, Florida. It is now apparent that the Deptford phase is much stronger on the northwest Florida Gulf Coast than had been formerly realized.

The 1959 Southeastern Archaeological Conference will meet November 13 and 14 at Ocmulgee National Monument, Macon, Georgia. The conference will center around a workshop on the problems of Southeastern ceramic typology.

Assembled by Charles H. Fairbanks

MIDDLE AMERICA

Central Mexico. A systematic archaeological survey of the Valley of Mexico has recently been initiated by the Dirección de Monumentos Prehispánicos of the Instituto Nacional de Antropología e Historia under the supervision of Ignacio Bernal. The Dirección de Prehistoria of the I. N. A. H. investigated a preceramic site at San Vicente Chicoloapan in the eastern Valley of Mexico. Less ancient than the Santa Isabel Iztapan mammoths and Tepexpan man, it is believed to be approximately coeval with de Terra's Chalco complex. Laurette Sejourné has completed excavations at Zacuala, near Tetitla, Teotihuacan, which exposed a very large palace-type structure with a number of well-preserved multicolored wall paintings which are being removed for inclusion with certain others in a gallery of prehispanic paintings. César Lizardi Ramos and Florencia Muller continued work at Huapalcalco, Tulancingo, Hidalgo, where a long sequence extending from Preclassic to Postclassic has been revealed. Roberto Gallegos excavated a series of burials at La Estancia, just west of San Juan del Río, Querétaro, which produced an interesting ceramic assemblage stylistically intermediate between Teotihuacan and Tula.

West Mexico. A University of California (Los Angeles) expedition, financed by Phil Berg of Los Angeles and directed by Clement W. Meighan, began extensive excavations in January at one of the largest sites of western Mexico, just north of the village of Amapa, near Santiago Escuintla, Nayarit. The site, located in the flood plain of the Río Santiago, covers an area of least a square mile and consists of a large number of mounds of various sizes, many systematically grouped around plazas. Preliminary ceramic analysis indicates a largely Postclassic occupation — Mazapan-like figurines and copper artifacts are relatively common — closely related to the nearby site of Peñitas which was excavated by another U. C. L. A. expedition in 1956.

OAXACA. At Monte Albán, Jorge Acosta discovered some important stone monuments bearing glyphic inscriptions. Ignacio Bernal worked in San Luís Beltrán, near the city of Oaxaca, a site providing post-Monte Albán edifices and pottery. The systematic site survey of the valleys of Oaxaca was also continued; more than 200 sites have been catalogued to date.

CHIAPAS. From September, 1958, through January, 1959, Robert M. Adams, Department of Anthropology, University of Chicago, assisted by T. P. Culbert and J. E. Knudsted, made an archaeological reconnaissance in the highlands of central Chiapas. Intensive survey and spot excavations were carried out in a rectangular area extending southward from Chanal and Chilil to Venustiano Carranza (San Bartolomé) and the Río San Vicente, an area extending down the northern slope of the Río Grijalva valley. The important Preclassic occupation near the river, recently revealed by the work of the New World Archaeological Foundation, is not paralleled in the adjacent highlands, where settlements remained small and sparse through not only the Preclassic but the Early Classic as well, then rapidly reached their most widespread distribution in Late Classic and early Postclassic times. Glottochronological studies by Norman A. McQuown suggest that the separation of the Tzeltal and Tzotzil languages dates from approximately the time of this population influx.

The Late Classic and early Postclassic occupations are confined to hilltop and ridgeline locations; the many defensive features of the sites strongly suggest a militaristic orientation for the period. Most of the sites are small, although at least one apparently attained true urban dimensions. Ceremonial structures consisted mainly of low, poorly finished platforms, but accompanying house terraces and platforms were mapped fairly completely. During late Postclassic times many sites seem to have been abandoned, and there is evidence of a concentration in the main valleys and basins. An important example within the area surveyed is the site of Copanaguastla where a large preconquest political center later became an important center of the Dominican Order. A map was made of the preconquest ceremonial center and its surrounding houses, as well as of the entire colonial town (abandoned around 1620) that adjoins it. Stratigraphic tests were excavated at four sites. A Late Classic and Postclassic sequence was obtained from Rancho San Nicolás and Copanaguastla, although a small chronological gap apparently exists between the two sites. Sequences from Teopisca and Amatenango, both modern towns, continue from the colonial period until the present, but provide no evidence of a prehispanic occupation.

Assembled by H. B. NICHOLSON

HIGHLAND SOUTH AMERICA

CHILE. In the provinces of Atacama and Coquimbo, Jorge Iribarren, director of the Museo Arqueológico of La Serena, conducted an extensive survey and excavations some 70 km. to the north of this town on several sites pertaining to the El Molle culture. Hans Niemeyer excavated a Diaguita burial ground at Puerto Aldea and discovered several stone cist graves with funerary offerings. In the central region of Chile, members of the Sociedad Arqueológica of Viña del Mar continued excavations in coastal shellmounds by which they established several local sequences of preceramic and early ceramic materials. In the northern provinces of Tarapacá and Antofagasta, Father Gustave Le Paige has continued his research and Grete Mostny of the Museo Nacional de Historia Natural in Santiago made a short local survey. The French archaeologist, José Emperaire, lost his life while carrying out extensive excavations in the Magellanic area. Emperaire was 47 years old and had been a staff member of the Centre National de la Recherche Scientifique, Paris.

COLOMBIA. The recent founding by the Instituto Colombiano de Antropología of a small museum at El Socorro, Department of Santander, in the Eastern Highlands, has created a certain interest in the hitherto unknown archaeology of this region. Near Guapota, some 20 km. from El Socorro, 14 burials were excavated and many whole pottery vessels with painted, incised, and appliqué decoration, were recovered. Similar burials were found at Oiba. On a nearby hilltop an L-shaped earth structure was discovered which will be excavated in the near future. These surveys were made by staff members of the Instituto, under the direction of José Rodríguez Bermúdez.

Members of an expedition of the Instituto de Ciencias Naturales of the Universidad Nacional de Bogotá to the Sierra de la Macarena, an isolated mountain massif on the headwaters of the Vichada River in the Eastern Llanos, discovered a large number of caves with evidences of prehistoric human occupation, well-preserved rock paintings, and remains of pottery. A survey and test excavations were conducted by members of the Instituto Colombiano de Antropología, under the supervision of José Rodríguez Bermúdez and Carlos A. Neissa. A great many unspecified pottery sherds and jasperite scrapers were found.

Near Zambrano, on the lower Magdalena River, Gerardo and Alicia Reichel-Dolmatoff excavated a 20-foot deep midden site which provides important links between the early Sinú and Ranchería cultures. Carlos Angulo Valdés of the Universidad del Atlántico in Barranquilla is continuing his excavations near Malambo on the Lower Magdalena.

Assembled by G. REICHEL-DOLMATOFF

SOME RECENT PUBLICATIONS

This annual listing has been compiled by the "Notes and News" editors. It does not include articles in AMERICAN ANTIQUITY or *Memoirs of the Society for American Archaeology*. After this year "Some Recent Publications" will be replaced by the proposed Abstract Series of the Society for American Archaeology. This list contains 610 titles.

The following abbreviations are used in the references:

AA	*American Anthropologist*. Menasha.
AAE-UC	*Anales de Arqueología y Etnología, Universidad Nacional de Cuyo*. Mendoza.
AHG	*Antropología e Historia de Guatemala*. Guatemala.
Ar	*Archaeology*. New York.
ASNJ-B	*Archaeological Society of New Jersey, Bulletin*. Trenton.
BAE-B	*Bureau of American Ethnology, Bulletin*. Washington.
BEO	*Boletín de Estudios Oaxaqueños*. Oaxaca.
CA	*Cuadernos Americanos*. Mexico.
CNHM-B	*Chicago Natural History Museum, Bulletin*. Chicago.
EP	*El Palacio*. Santa Fe.
ESAF-B	*Eastern States Archaeological Federation, Bulletin*. Trenton.
FIA	*Florida Anthropologist*. Tallahassee.
HPPR	*Homenaje al Profesor Paul Rivet*. Academia Colombiana de Historia, Biblioteca de Antropología, Bogotá.
ICA	*Proceedings of the Thirty-second International Congress of Americanists* [Copenhagen, 1956]. Copenhagen.
INAH	*Instituto Nacional de Antropología e Historia*. Mexico.
KK	*Kiva*. Tucson.
MAA	"Middle American Anthropology," *Social Science Monograph*, No. 5. Pan American Union, Washington.
Mas	*Masterkey*. Los Angeles.
MAS-B	*Massachusetts Archeological Society, Bulletin*. Attleboro.
MM-TR	*Museum Monographs, Tikal Reports, Numbers* 1–4. University Museum, Philadelphia.
MPROD	"Miscellanea Paul Rivet, Octogenario Dicata," *Universidad Nacional Autónoma de México, Instituto de Historia, Publicaciones, Primera Serie*, No. 5 (2 vols.). Mexico.
NYSAA-B	*New York State Archaeological Association, Bulletin*. Albany.
OAS-B	*Oklahoma Anthropological Society, Bulletin*. Norman.
P	*Plateau*. Flagstaff.
PA	*Pennsylvania Archaeologist*. Homesdale.
R	*Runa*. Buenos Aires.
RMEA	*Revista Mexicana de Estudios Antropológicos*. Mexico.
S	*Science*. Washington.
SAP-J	*Société des Américanistes de Paris, Journal*. Paris.
SJA	*Southwestern Journal of Anthropology*. Albuquerque.
SL	*Southwestern Lore*. Boulder.
TAS-B	*Texas Archeological Society, Bulletin*. Austin.
Teb	*Tebiwa*. Idaho State College Museum, Pocatello.
UC-AR	*University of California, Anthropological Records*. Berkeley and Los Angeles.
UCAS-R	*University of California Archaeological Survey, Reports*. Berkeley and Los Angeles.
UC-RU	*Universidad Católica, Revista Universitaria*. Santiago.
WA	*Wisconsin Archeologist*, n.s. Milwaukee.
WaA	*Washington Archaeologist*. Seattle.
ZE	*Zeitschrift für Ethnologie*. Braunschweig.

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